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SCIENCE AND TECHNOLOGY

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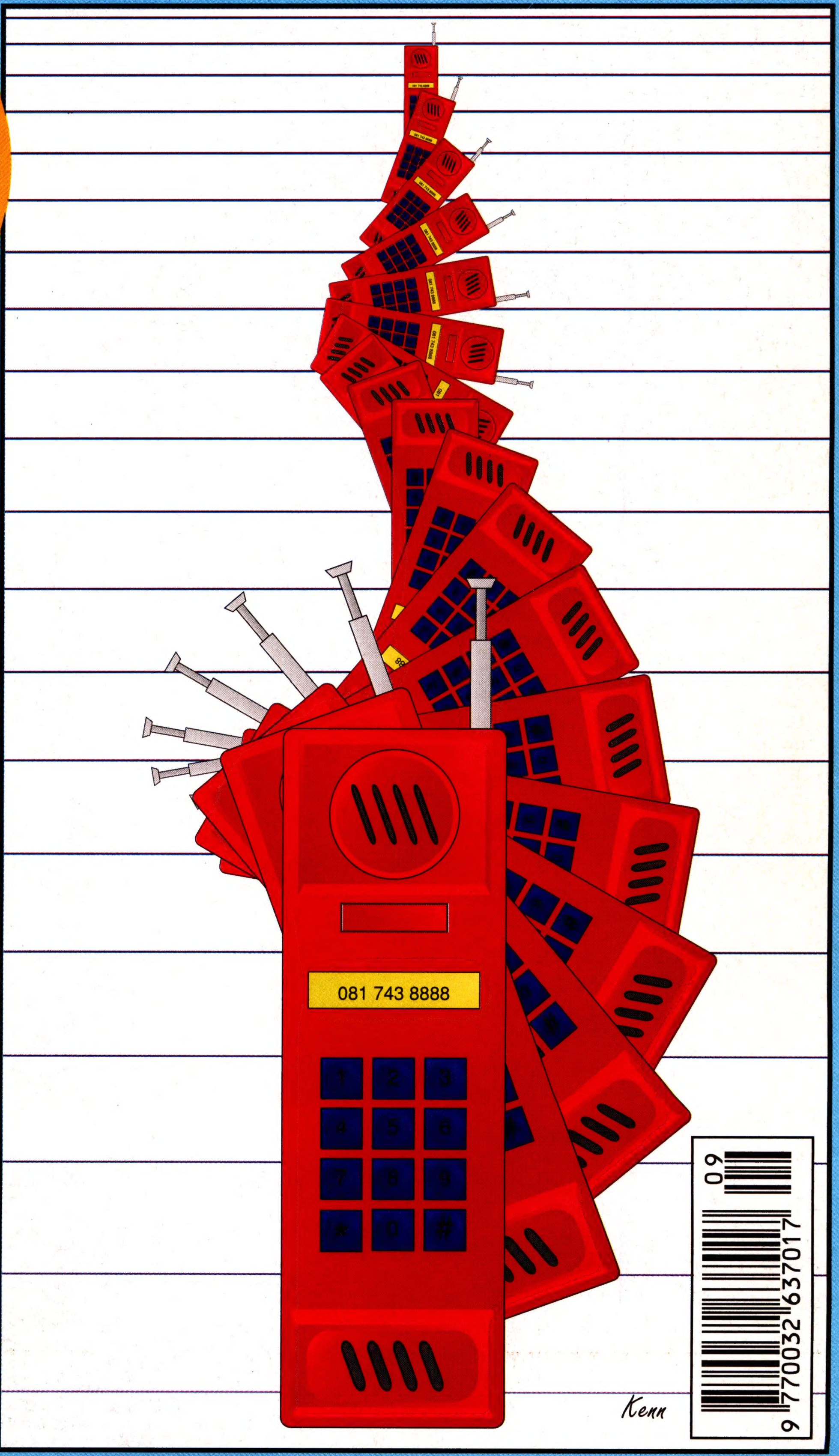


Raw Power

100W Hi-Fi project

Technology in action

Fax machines

Chicago CES

Sony's Mini Disc

How it works

The Video-camera

Multimeters

A Buyer's guide

Software

Three circuit sims

FREE INSIDE

16-PAGE GREENWELD CATALOGUE

Take the Sensible Route!

BoardMaker is a powerful software tool which provides a convenient and fast method of designing printed circuit boards. Engineers worldwide have discovered that it provides an unparalleled price performance advantage over other PC-based and dedicated design systems by integrating sophisticated graphical editors and CAM outputs at an affordable price.

NEW VERSION

In the new version V2.40, full consideration has been given to allow designers to continue using their existing schematic capture package as a front end to BoardMaker. Even powerful facilities such as Top Down Modification, Component renumber and Back Annotation have been accomodated to provide overall design integrity between your schematic package and BoardMaker. Equally, powerful features are included to ensure that users who do not have schematic capture software can still take full advantage of BoardMaker's net capabilities.

BoardMaker V2.40 is a remarkable £295.00 (ex. carriage & VAT) and includes 3 months FREE software updates and full telephone technical support.

AUTOROUTER

BoardRouter is a new integrated gridless autoroute module which overcomes the limitations normally associated with autorouting. **YOU** specify the track width, via size and design rules for individual nets, BoardRouter then routes the board based on these settings in the same way you would route it yourself manually.

This ability allows you to autoroute mixed technology designs (SMD, analogue, digital, power switching etc)in **ONE PASS** while respecting **ALL** design rules.

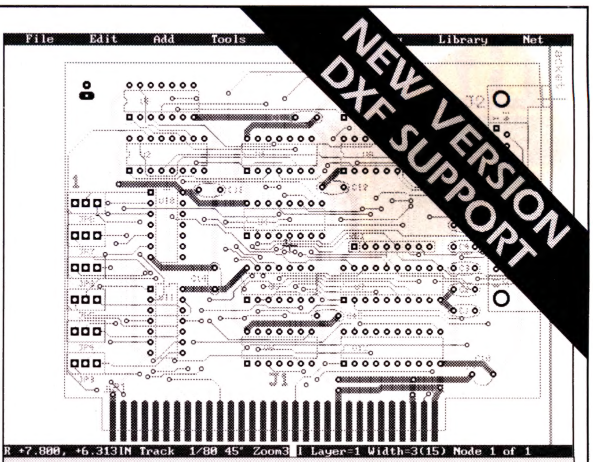
GRIDLESS ROUTING

No worrying about whether tracks will fit between pins. If the track widths and clearances allow, BoardRouter will automatically place 1, 2 or even 3 tracks between pins.

FULLY RE-ENTRANT

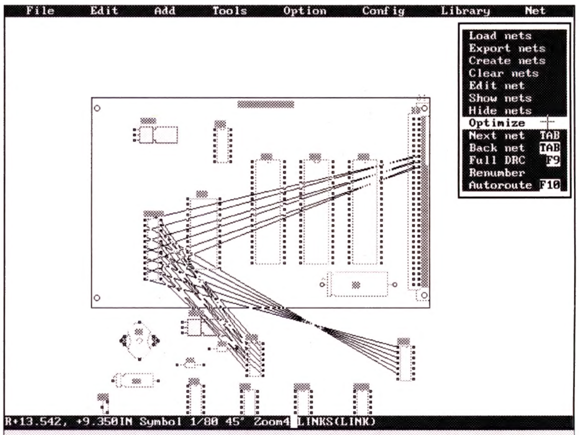
You can freely pre-route any tracks manually using BoardMaker prior to autorouting. Whilst autorouting you can pan and zoom to inspect the routes placed, interrupt it, manually modify the layout and resume autorouting.

BoardRouter is priced at £295.00, which includes 3 months FREE software updates and full telephone technical support. ***BoardMaker and BoardRouter can be bought together for only £495.00. (ex. carriage & VAT)***



```
R +7.800, +6.313IN Track 1/80 45' Zoom3 | Layer=1 Width=3(15) Node 1 of 1
```

Full analogue, digital and SM support - ground and power planes - 45 degree, arced and any angle tracks with full net-based Design Rule Checking.



```
R+13.542, +9.350IN Symbol 1/80 45' Zoom4 LINKS(LINK)
```

Optimized placement by displaying ratsnest per component. Lines indicate the unrouted nets.

HIGHLIGHTS

- Net list import from OrCAD, Schema etc.
- Graphical and manual netlist entry
- Top down modification for ECOs
- Forward and back annotation
- Component renumber
- Effortless manual routing
- Fully re-entrant gridless autorouting
- Simultaneously routes up to eight layers
- Powerful component placement tools
- Copper fill
- Curved tracks
- Extensive Design Rule Checking
- Full complement of CAM outputs
- Support and update service
- Reports generator
- Gerber, PostScript & DXF output
- Full SMD support

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This month...

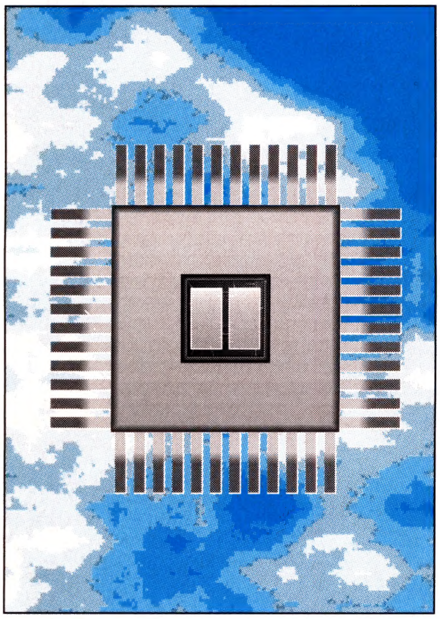
Computer aided design doesn't only apply to creating circuit schematics and PCBs. A couple of other applications are looked into this month with reviews of Pulsar and Protolab. Both of these are circuit simulators, the first dealing with digital and the second with analogue circuits.

The interesting point about simulation of electronic circuits is that when computers become small enough and fast enough, there should be no need to create a circuit out of discreet components. Instead, a black box with the required inputs and outputs will do the job. Inside will be a microprocessor that runs a simulation of the circuit.

However, that's in the future, anyone interested in getting into CAD now should turn to page 53 (after reading this) and enter our Seetrax Ranger competition. There is over £1500 worth of CAD software to be won.

Kenn Garroch, Editor

Next month...



Surface mount devices; how, what, where and why plus a project that uses them. AM stereo radio. How it works: we look inside a radio. All in the next issue of Practical Electronics.

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New technology could mean the end of video rental.

Editor: Kenn Garroch Advertisement Manager David Bonner Production Manager: Richard Milner Production Assistant: Michael Sullivan Office Manager: Laura Esterman Office Secretary: Wendy Rhodes Publisher: Angelo Zgorelec • **Practical Electronics Intra House 193 Uxbridge Road London W12 9RA Tel: 081-743 8888 Fax: 081-743 3062 Telecom Gold: 87: SQQ567 • Advertisements** The Publishers of PE take reasonable precautions to ensure that advertisements published in the magazine are genuine, but cannot take any responsibility in respect of statements or claims made by advertisers. The Publishers also cannot accept any liability in respect of goods not being delivered or not working properly. • © Intra Press 1991. Copyright in all drawings, photographs and articles published in PRACTICAL ELECTRONICS is fully protected, and reproduction or imitations in whole or in part are expressly forbidden. All reasonable precautions are taken by PRACTICAL ELECTRONICS to ensure that the advice and data given to readers is reliable. We cannot, however, guarantee it, and we cannot accept legal responsibility for it. Prices quoted are those current as we go to press. All material is accepted for publication on the express understanding that the contributor has the authority to permit us to do so. • Practical Electronics is typeset at Intra Press on Macintosh computers using Quark Xpress. Reproduction by Tetracolour Ltd. Printing by Andover Press, St Ives plc. Distribution by Seymour Press • **ISSN 0032-6372** •

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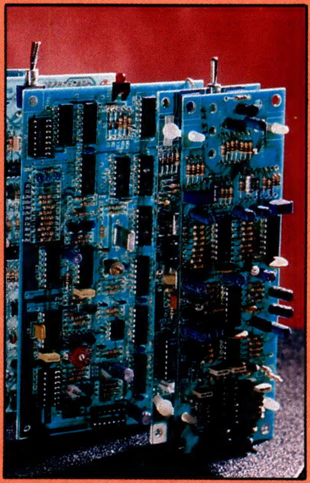

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CANAL PLUS/RAI INC. AUDIO *(DISCRETE)*	£155.65	£99.99
SECAM TO PAL CONVERTER *(SECAM)*	£99.99	£69.99
DUAL SECAM–RAI/CANAL PLUS *(DISCRETE/SECAM)*	£216.52	£149.99
RTL4 (DUTCH/ENGLISH)	£79.99	£39.99
STEREO MODULE	£99.99	£74.99
IF UHF MODULATOR NEEDED (NO LOOP THRU)	£15.00	£15.00
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Wavelengths

If you have any comments, suggestions, subjects you think should be aired, write to PE

With relation to the article by Mike Saunders in the November 1990 issue about lasers. I would like to know what happens if two lasers intersect. Is it possible to have two infrared lasers operating invisible beams and then make the intersection visible or, put another way, create a movable point of light in midair?

If this was possible, control of aircraft could be made three-dimensional instead of the present flat radar screen. Each moving light point would be an aircraft and it would be simple to see its light point in relation to other aircraft, its height, distance from the runway, even its position on the runway.

Using pulsed lasers it may even be possible to code a selected lightpoint to identify a particular aircraft.

H G Hartog
Lower Hutt
New Zealand

After asking our in-house optical experts on Astronomy Now, it seems that because the are coherent, laser beams do interfere with each-other when the intersect. Unfortunately, this has no visible manifestation at the point of intersection and can only be seen when the beams strike a surface.

As far as I know, light beams can't be seen unless they reflect off something – all the eye sees are reflections. Another way of looking at the whole idea is that if nobody has done this so far then it probably can't be done (unless somebody knows better?).

Transparent Translation

Reading through your article on constructing printed circuit board in the July issue of PE, I must admit to being a little confused. The circuit is obviously from the Frost Alarm in PE Feb 90 and appear to be printed upside down, or at least back-to-front. Looking at the photographs of the finished PCB, the tracks have the same orientation as those showing the layout over the page. Is this correct? It seems to me that they should really be reversed laterally so that when the transparentiser spray is used, the dark track lines are closest to the board giving a good image.

Can you clarify the situation?

A H Wills
Hampstead
London

You are quite right in saying that the image should be reversed so that the dark tracks end up closest to the board. The answer seems to be that the tracks are printed in the magazine so that transparencies can be made from them. These will be the right way around for this purpose but, as you point out, wrong for transparentiser. In the end, the only way to be sure of getting the correct image is to examine the board layout and reverse as necessary.

Radio Request

I have noticed recently that you have introduced a regular page called how it works. Can I make a request for something to cover? I would like to know about the humble transistor radio, can you oblige?

T Smith
Royton
Lancs

We aim to be of service, look out over the next few months and your request should be granted.

Fuzzy Logic

In the August issue of PE I noticed that page 28 tried to show the improvement of HDTV over standard PAL. Was there a printing mistake or is there no difference? All of the pictures are rather blurred and have lines across them.

A James
Norwich
Norfolk

There is a definite difference between the original photographs but, alas, production problems cause interference, the result of which is the lines and blurring – sorry.

Bad Boards

The quality of the PCBs on page 38 of the August issue of PE left quite a lot to be desired. Is this the best you can do? I would have thought that with all of the latest technology, computer aided design and so forth, you would be able to produce perfect images.

P Williams
Colchester

The problem here was that the artwork came from the original masters provided by the author. Fortunately, you should be able to provide better boards from Lys Electronics (see the advert later in this issue).

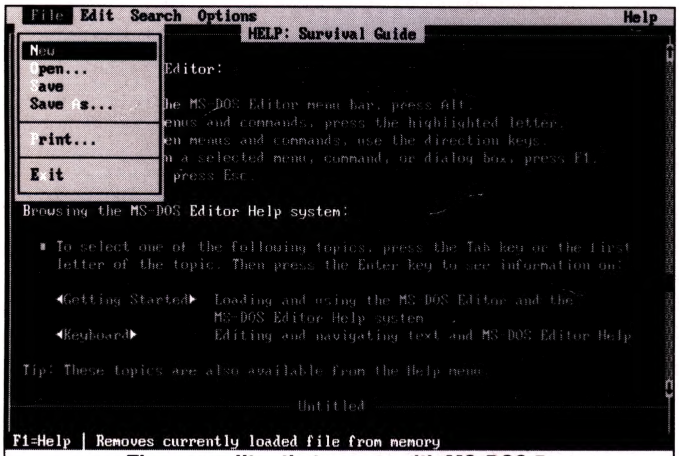
Sony's New Product

It was nice to see Ian Burley back with the New Product Developments replacement for Home Base. I like to keep track of what is new in the world of consumer electronics and your's is the only magazine that, now, seems to be covering this on a regular basis.

What I would like to know is whether the magneto optical technology used in the Sony mini-disc will be available for use with computers? It seems to me that this is the ideal media to store computer programs on. It is based on a digital system and appears to be small and quite rugged. The 74mins of music sampled at 44.1MHz should give 182 thousand mega words (at 16 bits per sample) or so – if my arithmetic is correct. This is a great deal larger than the average floppy or even the average hard disk.

A Henson
Stafford
Staffs.

All The Latest News From the World Of Electronics And Beyond...



```
Editor:

he MS-DOS Editor menu bar, press Alt.
enus and commands, press the highlighted letter.
en menus and commands, use the direction keys.
n a selected menu, command, or dialog box, press F1.
 press Esc.

Browsing the MS-DOS Editor Help system:

  ■ To select one of the following topics, press the Tab key or the first
    letter of the topic. Then press the Enter key to see information on:

    ◄Getting Started►   Loading and using the MS-DOS Editor and the
                        MS-DOS Editor Help system
    ◄Keyboard►          Editing and navigating text and MS-DOS Editor Help

Tip: These topics are also available from the Help menu.

                              Untitled

F1=Help │ Removes currently loaded file from memory
```

The new editor that comes with MS-DOS 5.

The Latest DOS

MS-DOS 5, the latest version of Microsoft's well known PC operating system was announced recently. Previous upgrades went some way to removing the bugs and making things easier to operate but, version 5 is a complete overhaul. While attempting to retain backward compatibility many software packages work without a hitch. However, some have a few problems and some, apparently, don't run at all.

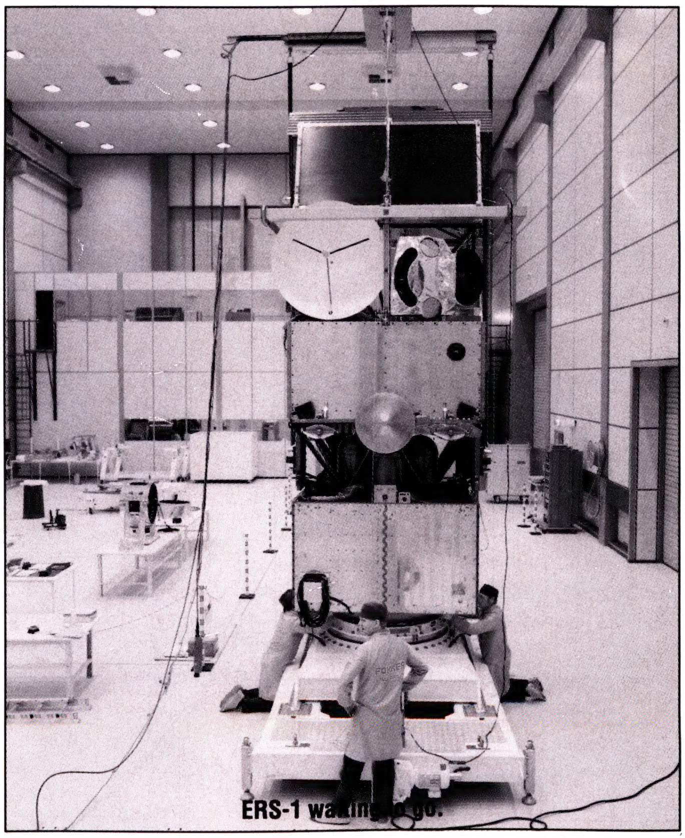
Among other features, a new DOS Shell has been provided to help anyone who doesn't like typing in long commands. This is basically a file management system like Xtreepro with the addition of context switching. It allows a number of applications to be started up at once and enables the user to move between them without exiting. Leaving one and moving to another is simply a matter of pressing a key – the current state of the program is saved to disk and the next program loaded in and activated. Although this is rather slow it can be used to run sa,y a wordprocessor, CAD system and, perhaps programming interpreter (such as the bundled Quick Basic) at the same time.

The other major improvement of DOS 5 over older versions is the improvement of memory management. If there is extended memory available on the machine – that is, memory above 640kb, say 2Mb – then 639k is left for applications. On the basic XT this is reduced to 591kb which is not bad. Other main additions are increased help on the various commands, a full screen editor to replace EDLIN and a QuickBasic interpreter. The upgrade pack is available from Microsoft (0734 500741) for £69.

ERS-1 Takes Off

The launch of the first European Remote Sensing Satellite, ERS-1 was originally planned for 3rd May 1991 but, due to various hardware problems was put back and back. It has now been re-scheduled to take off on 16th July from the European Spaceport in Kourou, French Guiana.

Fortunately, there was nothing actually wrong with the satellite itself, it was the third stage of the launcher that caused the problems. This has now passed its tests and should perform to specification during the launch.



ERS-1 waiting to go.

ERS-1 is the largest satellite ever to be launched by ESA and it carries sophisticated sensing devices that will reveal any environmental problems both at sea, on the ice caps and on land. The synthetic aperture radar will be able to take high resolution pictures of strips of the earth's surface 100km wide as well as measure the direction and length of sea waves from 100 to 1000m.

The satellite, after going through exhaustive electrical tests, will be mounted on the launcher at the beginning of July ready for launch on the 16th.

Three days later, ESA will be celebrating the 10th birthday of Meteosat 2, the second in the series of European weather satellites launched a decade ago.

Originally designed to have an operational life of three years, Meteosat 2 is still active and will take its final image on 19th July 1991. Its operational life was actually only the seven years between taking over from Meteosat 1 and being replaced by Meteosat 3. Many people will have seen images from this spacecraft as it was used in TV weather forecasting throughout its life.

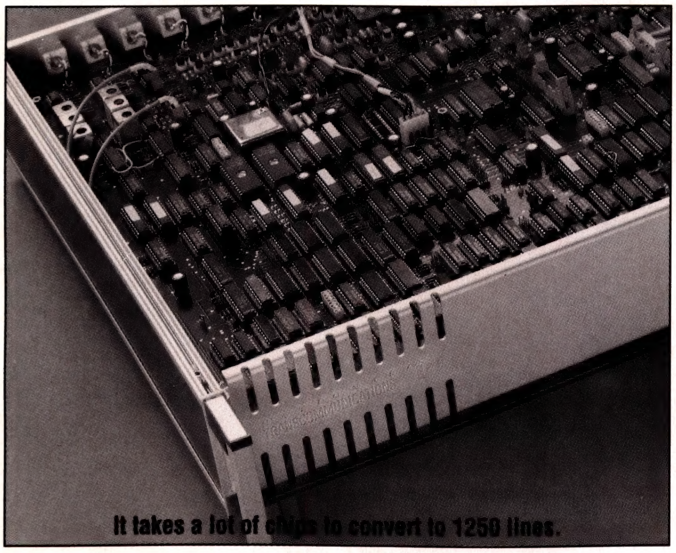
After taking its final picture, Meteosat 2 will be de-orbited allowing its position in the crowded geostationary orbit to be used by someone else.

Project VADIS

Project VADIS has just been announced as part of the Eureka programme for collaborative research. Aptly code named Eureka 625, VADIS is an acronym for Video-Audio Digital Interactive System and aims to develop the enabling technology to allow digital television with full 625 line resolution to be carried by bitstreams with speeds from 5 to 10Mb/s. The project will be divided up into five main sections.

The first job will be to define the range of applications to be considered by the VADIS project as well as the quality, data rates, video formats, security encryption and overall compatibility. Following this the algorithms necessary to compress the 216Mb/s video and audio data by 20 to 40 times to achieve the target 5 to 10Mb/s will be worked out.

The development of systems to multiplex video, audio and data into a single bitstream will follow on from the algorithm development until finally the hardware and software will be designed into VLSI chips to allow real applications to be created. After field trials are completed the eventual aim of the project will be to apply the technology in terrestrial and satellite broadcasting. An international partnership including most of the big names in telecommunications such as BT, the BBC, Olivetti, Philips, National Transcommunications, and Siemens, has an interest in the project which should see field trials underway by 1993.


It takes a lot of chips to convert to 1250 lines.

Up to 1250

To cater for the transfer between current and HDTV systems, the EDTV 1000 upconvertor from National Transcommunications is designed to convert from 625 to 1250 lines.

The usual chicken and egg syndrome means that someone will have to produce an HDTV monitor before anyone transmits an HDTV signal or vice-versa. To overcome this and encourage the release of HDTV monitors, National Transcommunications new device converts from interlaced to sequential scan (double line-rate) which reduces the line visibility and increases the vertical resolution.

Children On CAD

Part of the fun of being a child is getting your hands and face covered in paint when "learning to become an artist". For the new child that fun has been replaced by electronics.

Getting into CAD

The latest toy from Vtech is an electronic paintbox called Video Painter. Designed as a child's introduction to computer aided design (CAD), it sports a palette of 12 colours and a pen which can be used as either a brush or a crayon. Lines can be thick or thin, coloured or erased. The improvements over the standard paint and brush include a choice of six different patterns, an alphabet, a selection of backgrounds and a library of 50 predrawn images. These include shapes, animals, fantasy characters, vehicles and people, all of which can be used to make up a picture. Images can be enlarged, reduced, copied and animated.

When finished the art can be stored on video tape for later viewing – bringing a whole new aspect to home video.

Priced at £79.99 it will be available from department stores throughout the country.

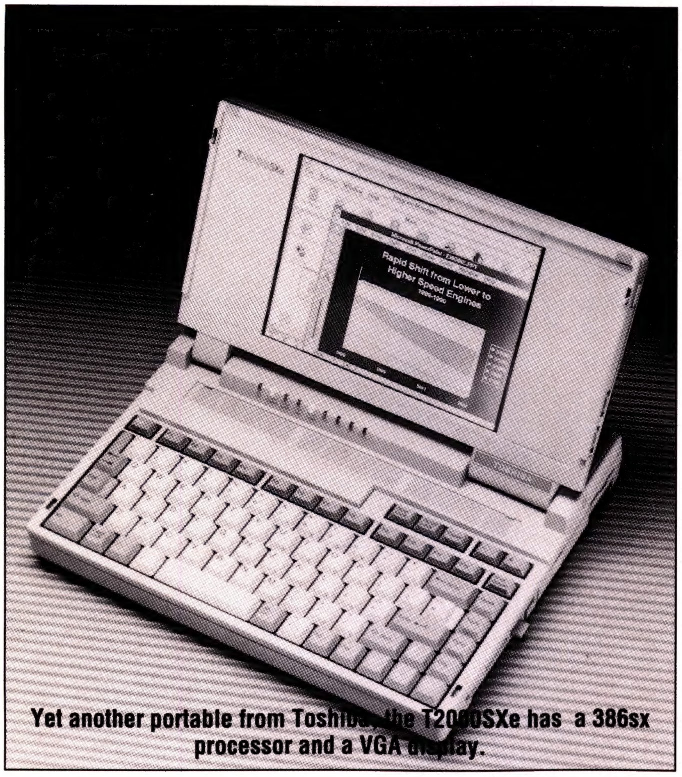
RGB Interface

Converting from RGB to composite video and UHF is now quite easy with the Wild Vision Chroma 100 series PAL coders.

Many modern computers, Commodore Amiga, Atari ST, IBM PC to name but a few, output their colour video images in analogue RGB. The separation of the red, green and blue signals from the synchronisation improves the image by cutting down inter-channel interference – it also makes the video output circuitry of the computer somewhat simpler. Most computers use DACs to convert the numbers in memory into voltages that represent the colour shades on a monitor. The drawback is that RGB is generally incompatible with most TV and video equipment which uses a combined signals made up from red, green, blue colours plus the vertical and horizon synchronisation information. Converting to composite video, as it is known, has, in the past, usually meant constructing some sort of special circuit.

The 100 series PAL coder takes 50Hz RGB and outputs PAL encoded composite video for both direct and UHF operation. The Chroma 135 has one composite and one UHF output. The Chroma 150 outputs two composite signals, two RGB and one UHF and incorporates a colour bar test pattern.

Priced at £129 for the 135 and £185 for the 150



Yet another portable from Toshiba, the T2000SXe has a 386sx processor and a VGA display.

they are available from Wild Vision, 15 Witney Way, Boldon Business Park, Boldon Colliery, Tyne and Wear, NE35 9PE, Tel 091 519 1455.

BT Gets Halfway

BT converts 15 telephone exchanges to digital operation every week and recently announced that it had converted half of the country.

Using the touch-tone dialling system the new exchanges offer much faster connect times plus a host of new facilities. Call diversion, call waiting, three way calling, repeat last call, call barring, charge advice, code calling and reminder call are just a few.

The trunk network which forms the backbone of the telephone system became all digital last year and was the first in the world to do so. It uses more than 1,500,000km of optical fibre allowing voice, data and images to be transmitted at high speed – it has another 10,000km added every week. The 3319th exchange, the halfway stage, was reached on 20th June this year when the Dean of St Paul's Cathedral in the City of London officially closed the old meachanical exchange and opened the new digital one.

Petit Duo

Toshiba, well known for producing portable computers has just announced the launch of the "smallest printer on the market". Citizen, known perhaps for its watches, has also launched the World's smallest printer. According to the specs, they appear to be based around the same engine.

Both machines have 24 dot matrix heads and can print on standard office stationary. The only difference seems to be in the sizes, the Toshiba measures 303x80x44mm and weighs 0.85kg whilst the Citizen is just 297x90x50 and weighs 1.17kg. The speeds, battery life and noise output appear to be just about the same as are the prices. The Toshiba Expresswriter 201 and the Citizen PN48 both cost £325.

No Tax

Back in July, PE reported that the new mobile telephone tax may apply to the telepoint phone. However, we can now confirm that this is definitely not the case.

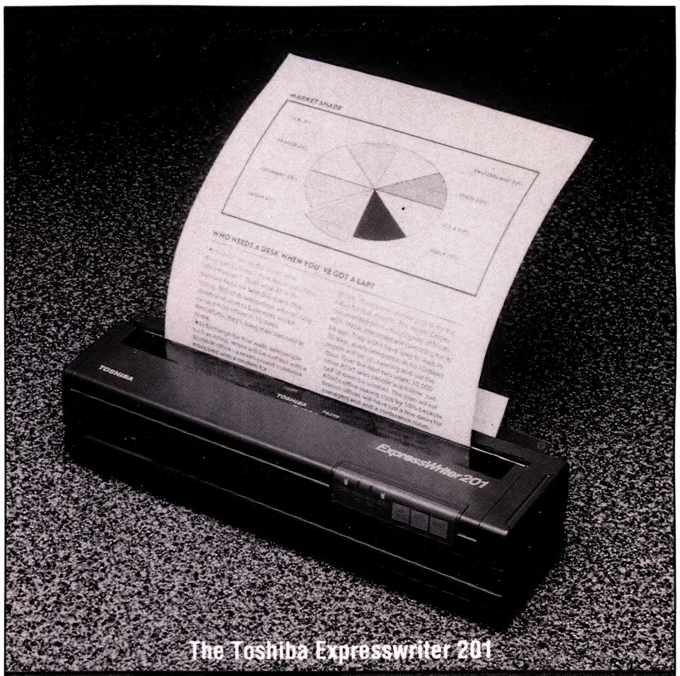
The Telepoint system is not classed as a mobile phone according to Roger Best MD of Phonepoint. Telepoint connects into the standard telephone network and does not make any use of radio frequencies set aside for mobile use.

The idea of the tax on mobile telephones was designed identify the mobile phone as a business perk. According to PhonePoint, the CT2 phone is a viable alternative for both residential and office communications, it costs less to operate and there is no comparison to mobile phones.

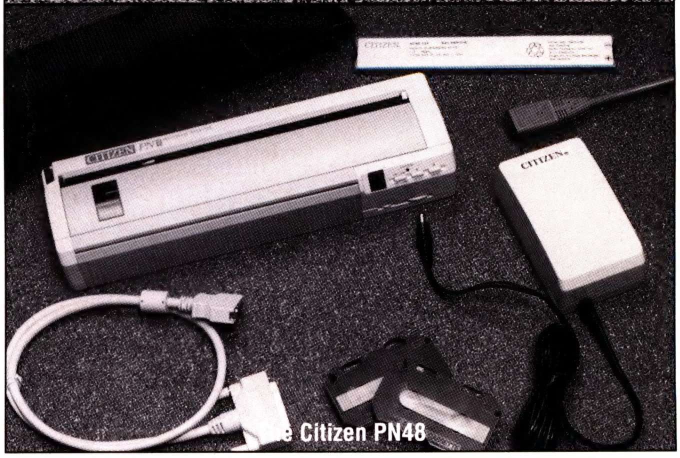
RSGB Mag

The Radio Society Of Great Britain announced the launch of a new bi-monthly full colour magazine. DIY Radio aims to introduce the fun of amateur radio to school children, housewives, disabled and senior citizens. Each edition will feature construction projects, equipment reviews, news stories, a wall poster, competitions and special offers.

The magazine is only available on subscription at £9 a year from DIY Radio, RSGB, Lambda House, Cranbourne Road, Potters Bar, Herts, EN6 3JE. ■



The Toshiba Expresswriter 201



The Citizen PN48

Animated Electronic Circuits

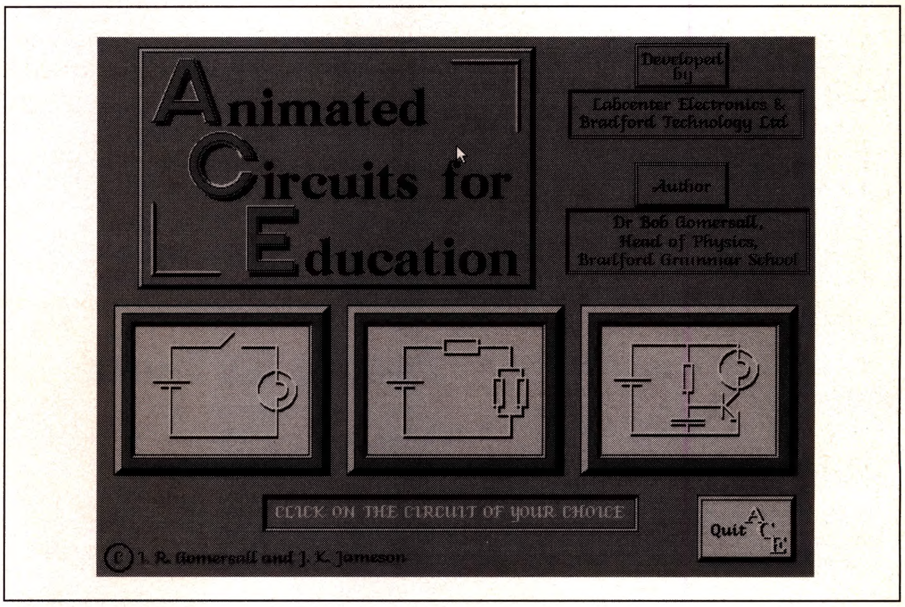
A new piece of software from Labcentre Electronics may revolutionise the way in which the concepts of electronics are taught.

ACE, a forthcoming product from Labcentre is breaking new ground in terms of animated electronic educational software. Circuits are displayed in an animated form that shows the current flowing through the components, meeting resistances, charging capacitors and triggering transistors. As the national curriculum for England and Wales states:

"Pupils should understand the behaviour of a circuit and its components in terms of a model of charge flow"

ACE sets out to do just this. The topics that will be covered in the package include:

- Conductors and insulators
- Series and parallel circuits with bulbs and resistors
- Measuring voltage, current and resistance
- Fuses
- Variable resistors
- Current voltage characteristics
- Internal resistance
- Capacitors
- Diodes and rectification
- Basic transistor circuits



The operation of the software is fully mouse driven and allows the user to point to components such as switches and click them on and off. Current flow is displayed in the form of animated dots with the various potentials in the circuit shown in different colours with different dot spacings. At the bottom of the screen are tape-recorder-like controls which start the current flow, stop it, single step it and eject to the next project.

Designed mainly for use in schools either as an "electronic book" or "dynamic blackboard", the software will also be available for the hobbyist.

Unfortunately, there is a major drawback with the system in that it will only work with an IBM-PC 286 (AT) or higher with MCGA or VGA graphics, it also has to have a mouse. Not too many schools will have these to hand and, although the authors are confident that the software will do well, it remains to be seen if there are enough machines available to allow widespread use.

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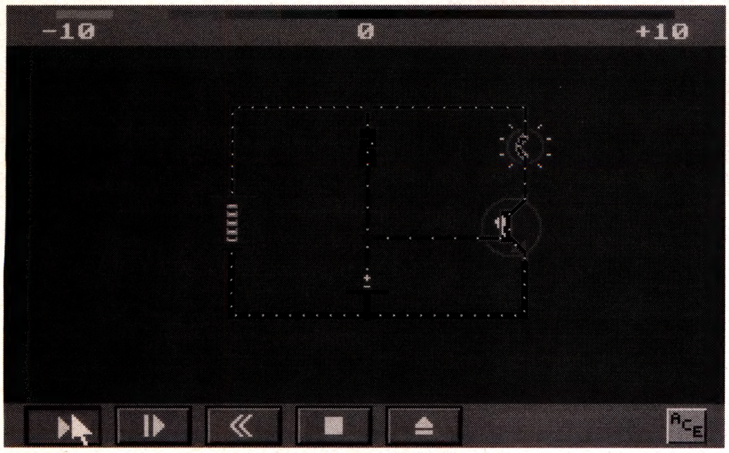


An animated transistor circuit.

Pump Up The Voltage

This month's trip down silicon valley examines a VGA LCD driver some new serial memory and high side power supply circuits.

Single Vision

The quest for the best personal notebook computer is driving the silicon industry to produce more compact and lower power chips. The latest is an LCD VGA controller from Cirrus Logic. The CL-GD6410 allows a complete VGA subsystem to be implemented using only five chips occupying less than four square inches.

On a monochrome system, the system provides 64 levels of grey and is capable of directly driving 512 colours using an active matrix LCD. In addition, the Simulscan feature enables the chip to drive an analogue CRT at the same time as the LCD.

The additional components required for a complete system are two DRAMs for the video memory, a clock synthesiser and, if a dual panel LCD is used, a 64kx4 "frame accelerator" memory. The latter can be used to run a 70Hz refresh rate with an input clock of only 14MHz, comparable systems must used a 28MHz clock. The reduce rate allows lower power consumption as does the shutting down of circuitry associated with the CRT when it is not being used.

Serial Interchange

Being able to access memory in a serial fashion is nothing new. However, where most systems have used three or four wires, the Xicor serial EEPROM family uses two. The idea is to allow the same chip socket to be used by devices offering 1k, 2k, 4k, 8k or 16k of memory. The same two pins are used on every chip to communicate with the microprocessor so changing from chip to chip is just a matter of changing the software. The two wire communications protocol also frees up a couple of controller input/output ports to be used for something else. Currently available from Micro Call Ltd (0844 261939) are the X24C01A 1k byte EEPROM and the XA24C08 8k byte EEPROM.

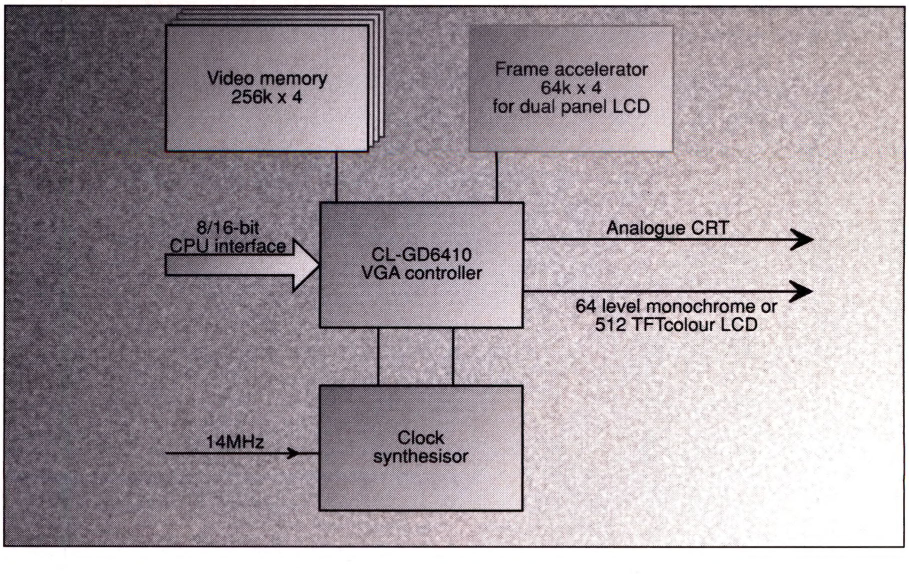
Pump Up The Voltage

The new high-side power supply integrated circuits from Kudos Thame are able to produce regulated 11V output from a 5V power supply. The term high-side refers to positioning of a switch between the positive supply and the load – low side switching is the opposite, the switch goes between the load and the negative supply.

The MAX622 and MAX623 are ideal for providing the higher gate voltages required by low-cost N-channel MOSFET switches. The high-side aspect of the system avoids the requirement for costly P-channel MOSFETs, PNP transistors and logic level MOSFETs in switching and control applications where only low supply voltages are present.

The chips operate around charge pump convertors which eliminate switching regulators and the associated cost, size and EM (electro-magnetic) interference of inductors. The MAX622 requires only three inexpensive capacitors for a complete circuit while the MAX623 has them built in and needs no external components.

Able to operate from supply ranges from +3.5V to +16.5V and having a quiescent supply current of only 70μA, they are ideal foe battery powered switching applications such as changing over from mains adaptors to internal batteries and battery load management. A useful facility is the power ready output which indicates that the high side supply has reached an operational level. For more information contact Kudos Thame on 0734 351010. ■



In The Beginning Was The Telephone

The modern office uses more technology than ever before. James Carter observes the current trends and looks at some of the latest gear.

Mac IIfx.

Before the telephone the height of office technology was probably the fountain pen. The telephone revolutionised communications, especially business communications and forced the start of a technology race that started with the typewriter and has so far reached the personal computer.

Jack Of All Trades

The first computers were huge unreliable affairs built up from hundreds of valves and taking up whole rooms. To begin with they were mainly used by scientists for research purposes but, by 1951, the first business computer had been built. The Lyons Electronic Office or LEO was custom built by J Lyons & Company to run the payroll and by 1957 was producing the weekly payslips for 15,000 employees. This machine was a far cry from the sophisticated desktop machines that are now commonplace and it was not until the advent of large scale integrated circuits in the1970s tha the size revolution began.

When microprocessor based systems first appeared the maximum memory was around 64k with 8in disk drives using an Intel 8080 and the CP/M operating system. Things moved on to 5.25in disks and a Zilog Z80 microprocessor but the basic operation was still the same. Many of the early PC applications appeared at this stage. Wordprocessing took off with the infamous Wordstar and databases and spreadsheets started to become commonplace. However, until the increase in processing power enabled high resolution video screens to be catered for, graphics applications and games were quite rare and nothing compared to what is available nowadays.

Modern personal computers fall into three main categories, those built around the IBM PC architecture using the Intel 80x86 range of microprocessors, the Macintosh range, manufactured by Apple and the rest; Unix, Xenix, CCPM, Sun workstations and so on.

The IBM PC compatible is the main workhorse of the small and medium sized office. The bottom of the range machines, known as the PC XT, use the Intel 8088 or 8086 microprocessor and have between 512kb and 640kb of memory. Disk storage is mainly on floppy disks though small hard disk drives capable of holding 10Mb to 20Mb are now cheap enough to be added on. These machines are generally used for wordprocessing, running small payroll and accounting systems and small spreadsheets. Unfortunately they are slow and have now been superceded by the IBM AT which comes with a hard disk drive as standard and an Intel 80286 (i286) microprocessor. Giving up to ten times the processing speed it is able to run reasonably sized databases and large spreadsheets. A limitation is the

Compaq Deskpro 486/50L runs at 50MHz providing very high performance.

i286's inability to run programs properly in areas of memory larger than 640kb.

One of the big advantages of the PC type machine is its expandability. By placing extra printed circuit boards or cards in the back, its capabilities can be considerably enhanced. Cards are available for a wide range of applications from high definition video displays and MIDI (Musical Instrument Digital Interface) controllers to extra hard disk drives and modems.

Most of the latest PCs use the i386 microprocessor which improves the processing speed dramatically and gives access to more memory.

At the top of the range are PCs using the latest Intel microprocessor, the i486. These are still in the minority but are finding applications in banking with large spreadsheets and other applications that require very high performance in a small desktop computer.

Although not as widely used as the PC, the Apple Macintosh range of computers has had a very large effect on the way in which software is presented to the user. The GUI or graphical user interface was pioneered by Apple in its early Macs. Instead of the command line interpreter and the dreaded A> prompt, windows, icons, a menus and a pointer (WIMP) are used to manipulate files and data. By setting standards for ways in which things are done, the time taken to learn a new application is dramatically decreased. In addition, the inhearently graphical nature of the machine means that it finds many applications in desktop publishing (DTP). The difference and rivalry between the Mac and the PC is such that dedicated users of either machine won't even consider the other – Mac users are among the most evangelical of computer people.

The future of the office computer seems to be heading towards smaller and more powerful machines. Laptop computers offering the similar power to large desktop PCs are becoming common and they have the advantage that they can be folded up and put away when not in use instead of taking up a large chunk of desk space.

Getting It Out

The essential add-on or peripheral for the office computer is a printer. This provides a way to reproduce the results of an application in hard-copy form. In the early days, the quality was not considered too

Canon LBP 4 laser printer.

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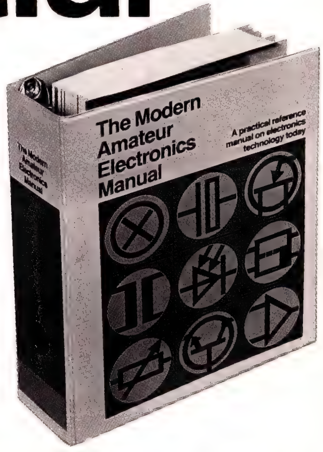
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important since printouts were only for payslips, account listings and so on. As wordprocessors developed the quality of printouts had to improve to compete with typewriters. The first high quality systems employed daisy wheels – a rimless spoked disk with a letter on the end of each spoke. Spinning the daisy wheel until the required spoke was in position and then using a solenoid to punch it onto the paper through a ribbon allowed print of the same quality as typewriters to be produced. The main drawbacks were speed and noise pollution – a daisy wheel printer in action sounds a bit like the start of a revolution.

The main competitor to the daisy wheel, the dot matrix printer, originally produced poor quality output since the characters were made up from a matrix of points and the resolution was only about 72 dots per inch (dpi) vertically and horizontally. This could be improved by overprinting characaters so that the dots didn't show too much but was still not as good as the noisy daisy. The major improvement for dot matrix printers came with the increase of the number of dot wires in the print head from 9 to 24, increasing the resolution to around 210 dpi. Unfortunately by this time, the laser printer had come to the fore and was falling in price offering 300 dpi at much higher speeds – up to 18 pages a minute – all very quietly. In addition they offered a selection of printing fonts allowing output that was almost indistinguishable from professional printed matter.

Most offices are now able to produce very high quality documents but are limited by the laser's monochrome output.

Colour printers, though still expensive, are now available that give 300dpi resolution and 16.7 million colours in a box the same size as a laser printer and at only a quarter of the speed.

Computer Speak

Communications is what holds modern commerce together. Since its invention in 1876 by Alexander Graham Bell, the telephone has been the mainstay of business. It has evolved far beyond the wildest dreams of the early pioneers with its ability to reach pretty well anywhere on the globe in under a minute. Obviously there has to be a telephone at either end of the link but the system has now become so widespread that, in many countries it is taken for granted.

Apart from simple voice contact, the telephone is also used for the transfer of data and images. The modem (moduator demodulator) is the device which allowed high speed communications between computer to become commonplace. The facsimile or fax machine depends upon it for its operation.

The Fax uses a long CCD (charge coupled device) sensor positioned at right angles to the paper to scan

IBM is one company with its eye

the image as it is moved past. The data is coded up either as ons and offs for black and white, or as a representation of the darkness of the image, and then pushed through a modem and converted into tones compatible with the telephone line. At the other end another fax pulls in the signals in through its modem and converts them back into an image using an electronic print head that generates marks on heat sensitive paper. A single page of A4 can be transmitted in under a minute allowing both text an images to be efficiently transferred from place to place.

The other main use for the modem is in communicating between computers. Until recently this was used mainly to send data from a host of satellite computers to a central system which could, for example, collate the days sales from around the country.

On a mainly amateur basis, the bulletin board has been around for some years. It provides a central computer upon which data can be stored and messages (E-Mail or electronic mail) left to be picked up by other computers as they ring in. This has developed into the on-line information service which provides data on everything from a synopsis of the days's newspapers and stock market reports to multi-user interactive games such as MUD (Multi-User Dungeon). The other development has been the rise of the on-line conferencing system. Pioneered by Byte, the US computer magazine. The UK version, CIX, has conferences covering a wide range of subjects.

Data Stores

The next major innovation which will change the operation of the modern office is the CD-ROM. This provides a vast amount of data in a small compact unit. Although not widely used, disks containing the UK telephone directory and the Oxford English Dictionary provide quick access to vital data.

The main problem with CD ROM units is that there is no set way in which to access the data onthe disk. Each tends to have its own programs to do this, some are good, others are pretty awful. Hopefully increased demand will force the manufactuers and publishers to get together to create a standard format.

The End of The Office

The increased capability and decreased price of office technology could eventually spell the end of travelling to work.

It is now quite possible to set up an office at home with all the essentials, computer, printer, fax, telephone and modem, all fitting on a single desktop.

Whether the advantages outweigh the disadvantages isn't known yet as working at home is still on a small scale. However, not having to commute to work every day definitely has its plus points. ■

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Who Said The Valve Was Dead?

Jeff Macauley's high quality audio amplifier has been tested by the most discerning listeners we could find. The verdict? "Excellent".

What makes a good power amplifier? A simple enough question you may think but the answer depends on who you ask. There are many in the audio fraternity who would suggest that only valve amps posses good sound. Others believe that valve sound is a load of hokum and would point to solid state reliability and minuscule THD (Total Harmonic Distortion) figures. Yet others believe that any amp can be improved by stuffing the circuit with expensive components.

The first thing to realise is that an amplifier is a device which makes an enlarged copy of an input signal. To so this without violating the laws of physics the extra energy is supplied by a DC power supply. Obviously in order to produce a good copy the first requirement is that the power supply voltage should not vary with the changing signal level. This is a tall order and the reason why many people have expended a great deal of money on super power supplies. An easier and definitely cheaper method is to design the circuitry so that it ignores power supply variations. Properly done this is much more effective.

Another train of thought suggests that amplifiers should be designed with the minimum amount of components on the principle that the less circuitry there us, the less sound degradation there should be. This is the minimalist approach. Certainly it is quite possible to build equipment with very few components but Hi-fi, they are not. How good an amplifier is is determined by how closely he output resembles the input. Unfortunately most active devices are far from linear so to do a good job of copying a fairly complex circuit is required to compensate for any shortcomings.

A similar school of though suggests that negative feedback should be banned in audio design. Again, this would be okay if active devices were truly linear. Unfortunately, this is the real world and they're not. Furthermore, many feedbackless designs incorporate local negative feedback to linearise the individual devices.

In The Beginning

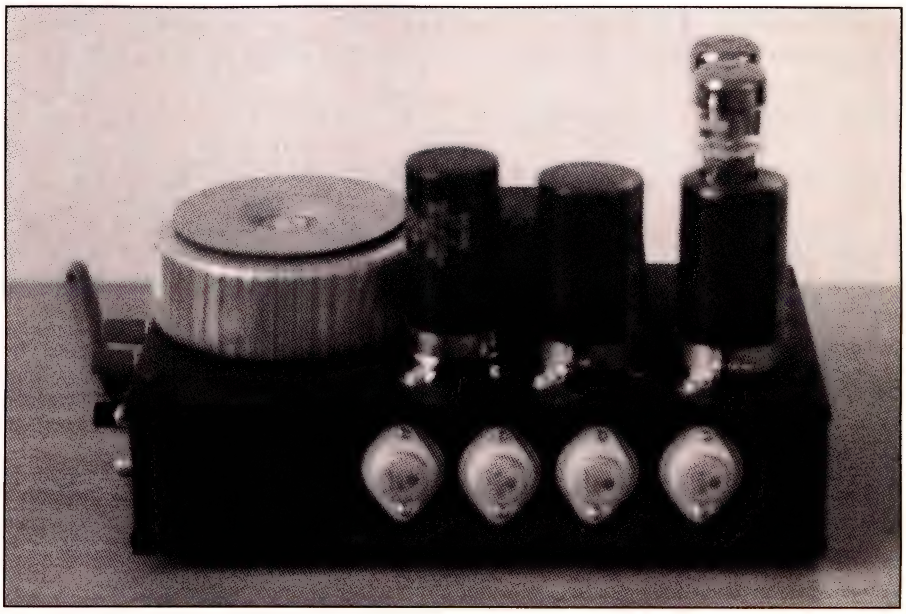
The starting point for any circuit is the engineering specification. The design objective was to supply 80W into 8Ω loads. At this point we can work out the required RMS (Root Mean Squared) from the relation:

$$V_{RMS}=\sqrt{(PR)}$$

where P is the required power and R is the load resistance. This works out at just over 25VRMS. The peak to peak voltage is some 2.8 times greater at about 71V. Similarly the peak current requirement can be calculated at 4.5A. Obviously these are the bare minimum figures and any practical circuit will require extra margins to cope with stage saturation and power supply regulation.

These considerations set the parameters of the output devices which in turn set the driver stage specifications. It is customary, with power amp circuits to describe operation from the output stage backward. This convention has, presumably, come about because the output stage is the heart of an amplifier. Indeed the rest of the circuitry merely supports the output stage's critical rôle.

There are plenty of suitable power transistors that could have been used but for this circuit VFETs were chosen. When these were first introduced a few years back they were heralded as the successors to



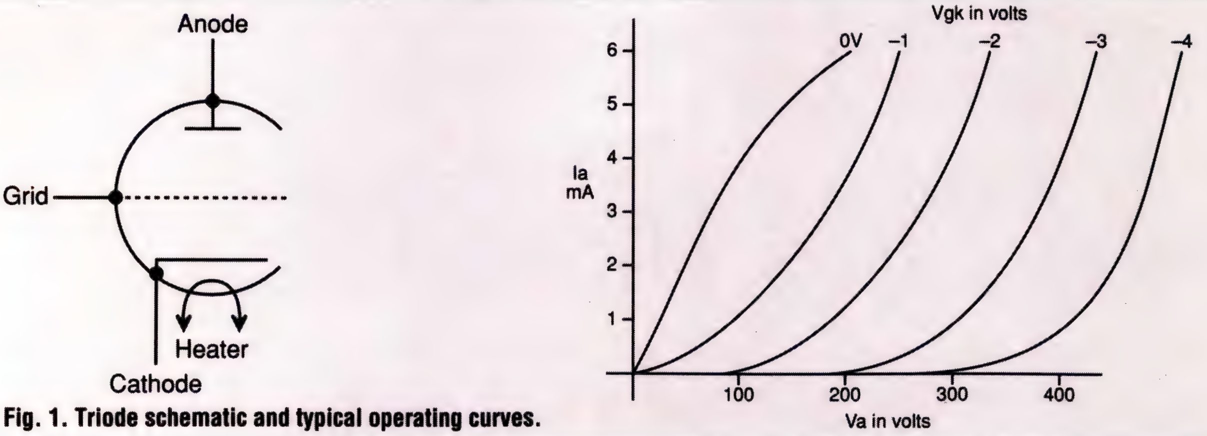


Fig. 1. Triode schematic and typical operating curves.

bipolar transistors.

They certainly have a lot going for them. For starters, they are immune to short circuits, have exceptionally high input impedance and tend to turn themselves off when they get hot. This latter feature is extremely significant.

It means that the amount of heatsink required is determined solely by how hot you can tolerate the heatsink. Normal bipolars on the other hand will self-destruct unless elaborate precautions are taken to ensure that the temperature rise stays within strict limits.

Another advantage of the VFET is that its operation at low currents is far more linear than normal transistors leading to better crossover performance. In fact the only fly in the ointment is the large gate to source capacitances of these devices. These need to be charged and discharged with every signal cycle. However, by using the devices in the source follower mode this capacitance is effectively bootstrapped reducing drive requirement. Probably the only reason that we still use bipolar output stages at all is one of economics. VFETs, at present, cost about three times more than equivalent bipolars.

The devices chosen for the output stage are a complementary pair rated at 140V and 12A peak current. More than adequate.

In The Circuit

Starting at the output if the system, Q4 and Q5 are used in the source follower mode. Equivalent to the more familiar emitter follower configuration found in bipolar circuitry. Together they form a fully complementary output stage. The only additional components, R5 and R6 are included to ensure stability. Output signals are coupled to the speaker by C3. An important point here is the DC blocking action of this capacitor.

Although a fault in the output stage is almost unheard of with these devices, it's still possible. If, for example, Q4 or Q5 were to become short circuited a directly coupled speaker would not last long enough for the plug to be pulled out. Speaker systems are very expensive compared to VFETs...

In order to drive the output stage properly, the driver circuit must be capable of charging and discharging the gate source capacitances whilst maintaining correct bias to avoid crossover distortion. For this reason the driver stage operates with 5mA of current.

The driver itself is a hybrid cascode comprising Q1 and V1. The first needs to have a high gain and low noise. The device used is actually half of a SSM2210 dual transistor per channel. This device features a noise voltage of only 0.7nV/√Hz and a guarenteed high current gain of 550 at 10µA collector current. The high gain means that the device makes an excellent voltage to current convertor. Note the absence of an emitter resistor. This is because the transistor is being used 'open loop'.

The only resistance in the circuit is the internal emitter resistance. In a silicon transistor this is equal to 26/IcΩ where Ic is in mA.

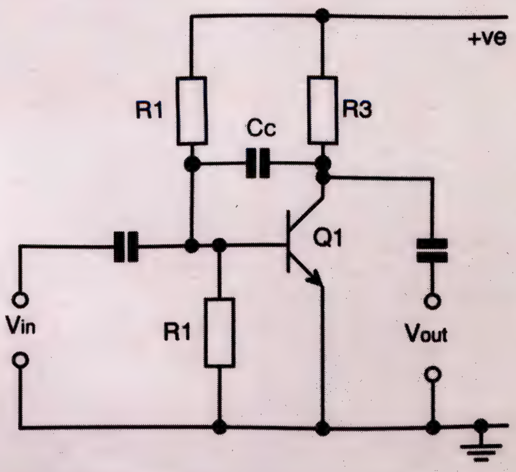
The series pass element is the valve V1. This needs to be a device of rather special qualities to accurately transmit the current

The Cascode Amplifier

The cascode circuit first saw the light of day as an RF amplifier and has a substantially better response than the usual common emitter stage normally encountered as a voltage amplifier.

Fig. 2a shows both a common emitter amp with a simple cascode in 2b. Looking first at the common emitter stage, this acts as an efficient voltage amplifier but suffers from a couple of disadvantages. The major one is that the parasitic collector to base capacitance Cc allows high frequencies to to find their way back to the base. This gives unwanted negative feedback at high frequencies and is known as the Miller effect. This gives premature curtailment of high frequency response.

From the point of view of an audio amplifier the overall performance of the common emitter stage is disappointing. Apart from the high frequency drop off, the input impedance

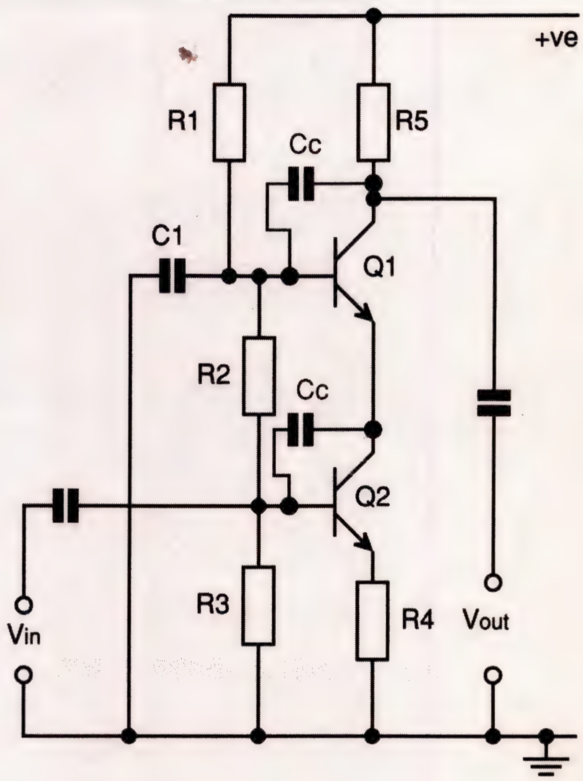


is low and the distortion, especially at high output levels will be high. Output impedance is also quite high depending on the value of the collector load resistor.

Fig. 2b shows the basic cascode stage. This has two transistors connected in series. Q1 and Q2 are biased from the resistive divider R1, R2 and R3. C1 removes any AC signals from the base of Q2. Due to normal transistor action the emitter will sit at about 0.6V below the voltage applied to its base. It therefore provides a smooth DC level for Q1. Q1 is actually operating as an emitter follower. Signals across R4 will mirror input signals applied to the base both in amplitude and phase. Q1 has two functions. Firstly it converts the incoming signal into current variations to drive Q2 – it is a transconductance amplifier. Second, it provides a fairly high impedance to the input. Because the voltage at Q1's collector is held constant by Q2's emitter Miller feedback through the parasitic capacitance Cc cannot occur.

Q2 is operated in the common base mode . Current from Q1 appears across R5 as an output voltage. Because of the high drive impedance produced by Q1's collector, the operation of this transistor is extremely linear. Again, the parasitic capacitance between the collector and base has no real effect because C1 effective;y earths signal voltages fed back to its base.

The cascode is a fair imitation of a perfect amplifying stage from the viewpoint of linearity. The HF response is also many times more linear than the common emitter stage.

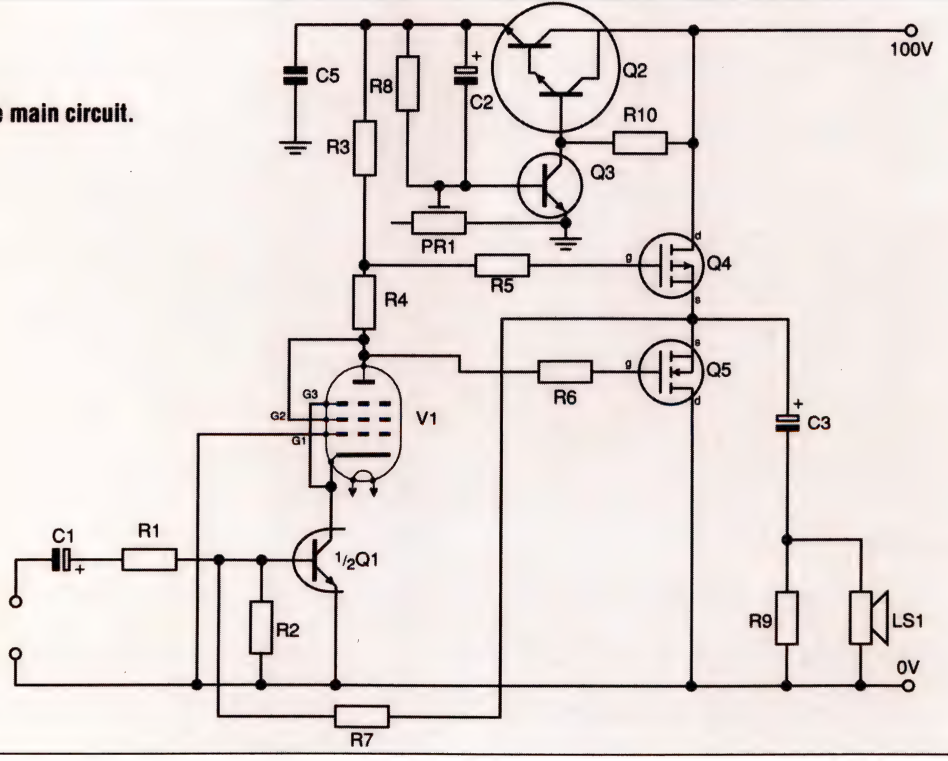


signal provided by Q1.

At this stage it is as well to describe exactly why a valve is being used in the circuit at all. To start with, a transistor would have lost signals due to the base current since a transistor operates by current amplification. The base current will therefore vary during each signal cycle resulting in distortion.Using a suitable;le FET instead of V1, would introduce the problem of source gate capacitance. Although the input impedance is low, most available devices would suffer from loss of top due to this capacitance shunting high frequencies to ground. Lastly, valves are very linear devices, more so than the majority of FETs and their characteristics are nearly constant from device to device – something that cannot be said of either transistors or FETs.

The valve is essentially the ideal device for this application. When used correctly the cathode current equals the anode current at all signal levels. Very low grid cathode current ensures that all the signals get to the output regardless of frequency. By using this hybrid configuration the best of all possible

Fig. 3. The main circuit.



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The Triode

The electronic age started in 1907 when an engineer name De Forest produced the world's first amplifying device, the triode. It had been known from Edison's experiments that a current flow could be produced between a heated filament and a metal plate inside an evacuated glass bulb when the plate was held at a positive potential compared to the filament. It was also observed that the current wouldn't flow when the plate was made negative with respect to the filament.

The reason for this rather puzzling state of affairs is that a heated filament in a vacuum ejects free electrons from its surface. A nearby positively charged plate will attract these so a current flows between them. Conversely, a negatively charged plate would repel these electrons and no current is able to flow.

All of this describes the operation of a diode and for years the main use of this device was detection of spark gap transmissions. What De Forest did was to introduce a third electrode in the form of a fine wire mesh between the filament and the plate. By varying the DC voltage on this new electrode, the grid, the current flowing could be altered. A relatively small grid voltage causes large variation in current. Connecting a suitable resistor in series with the plate creates a voltage amplifier.

This basic device is the simplest valve possible, a triode. Modern components use an indirectly heated cathode but basically the circuit is the same. As an amplifying device the valve is some ten times more linear than a transistor although the gain it produces is relatively small, between 10 and 100 times depending on the type. The separate heater is obviously a disadvantage compared with a transistor. However, the input impedance of the valve grid is very high.

The nearest equivalent device in the solid state arsenal is the junction field effect transistor (JFET). However, the valve, being a mechanical device can be made with very little gain variation between samples of the same type, even when obtained from different manufacturers. Compare the average 10% variability of a valve to the 4:1 gain ratio expected between different samples of transistors of one type. Also valves are high voltage devices giving much greater signal swings than transistors and generally suffer from less parasitic capacitance than either transistors or FETs.

worlds is obtained with very high linearity before feedback is applied.

The valve, an 6CA7, is an output pentode more normally encountered in the output stages of high power amps. Here, to improve the linearity of the circuit, the valve is being used as a triode.

This is achieved by connecting G3 to cathode and G2 to the anode. G1, which would normally be the input terminal is connected directly to ground. The consequence of this is that the cathode voltage is raised above ground by a few volts and this voltage acts as a low impedance stable supply for Q1.

Triode connection ensures that the anode and cathode currents are identical. It also alters the characteristics of the valve which become far more linear. The choice of the 6CA7 is deliberate in that it is one of the few valves on the market that can supply the high voltage swings necessary when operated from a low voltage source. Also, this allows the whole circuit to be directly coupled ensuring better transient response and no phase problems at the frequency extremes.

The performance graph of the valve is shown in Fig. 4. Note that the load line, the line which cuts the anode current/voltage to grid voltage lines, intersects the current axis at twice the quiescent value and the voltage axis at 95V. The limits of performance are indicated by the points at which this load line crosses Vg1=0V line.

The rest of the driver circuit consists of R4 and R3, connected in series. Here the simplicity of a VFET output circuit comes to the fore. Bias is set simply by the voltage drop across R4. Similarly there is no need for the usual small value resistors in series with the output devices to prevent crossover distortion.

Because we have open loop gain in the driver circuit it is possible to produce a very simple high quality amplifier by using shunt feedback. The output voltage at the source of Q4 and Q5 is applied to the voltage divider comprising R7 and R2. As a result the voltage at the output will rise until 0.6V is applied to Q1's base where it stabilises. By suitable choice of R7 and R2, the output is held at the correct voltage for maximum linear output voltage swings.

With a shunt feedback amplifier of this kind, the feedback reduces the input impedance seen at the base of Q1. As far as signals are concerned it's virtually at earth potential – which is why its called a virtual earth amplifier. The voltage gain is set by the ratio of R7 to R1.

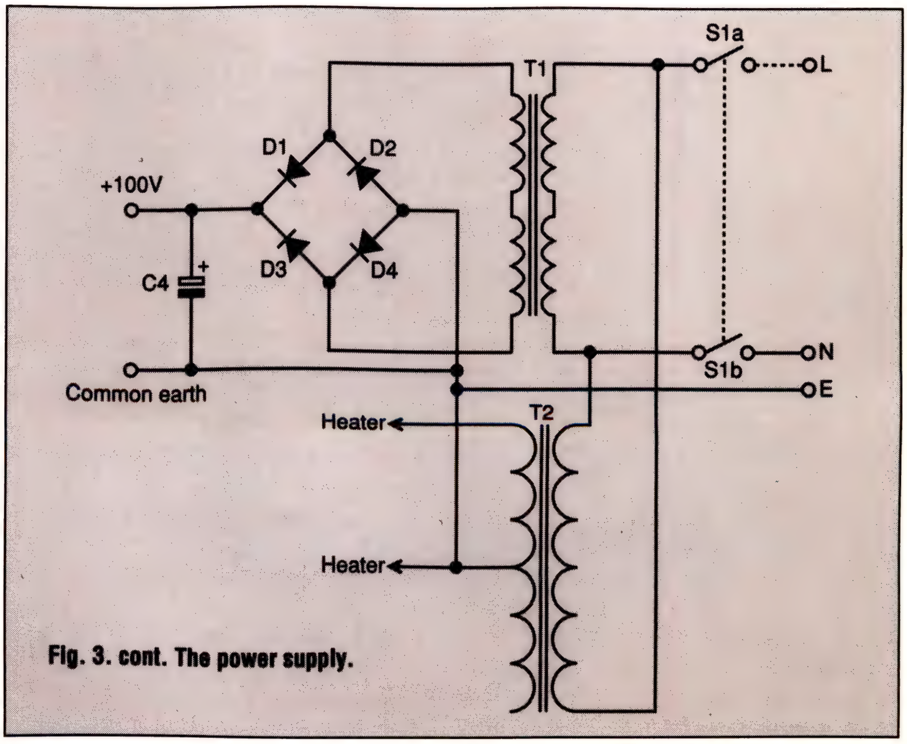


Fig. 3. cont. The power supply.

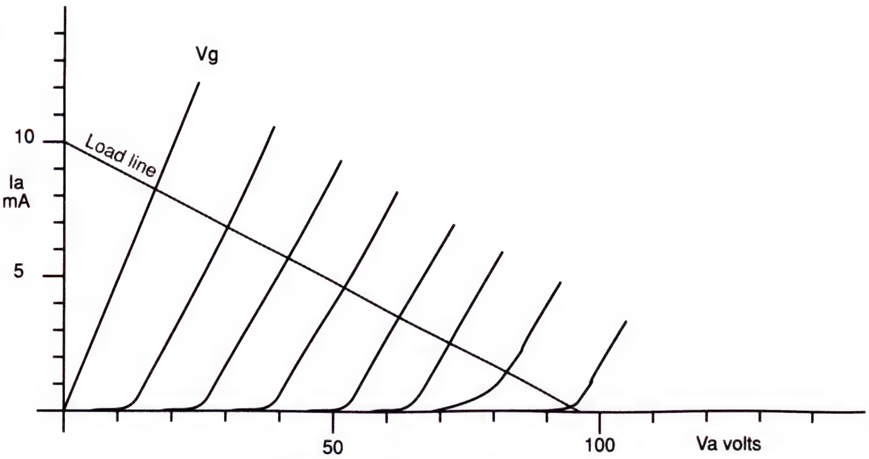


Fig. 4. 6CA7, triode connected.

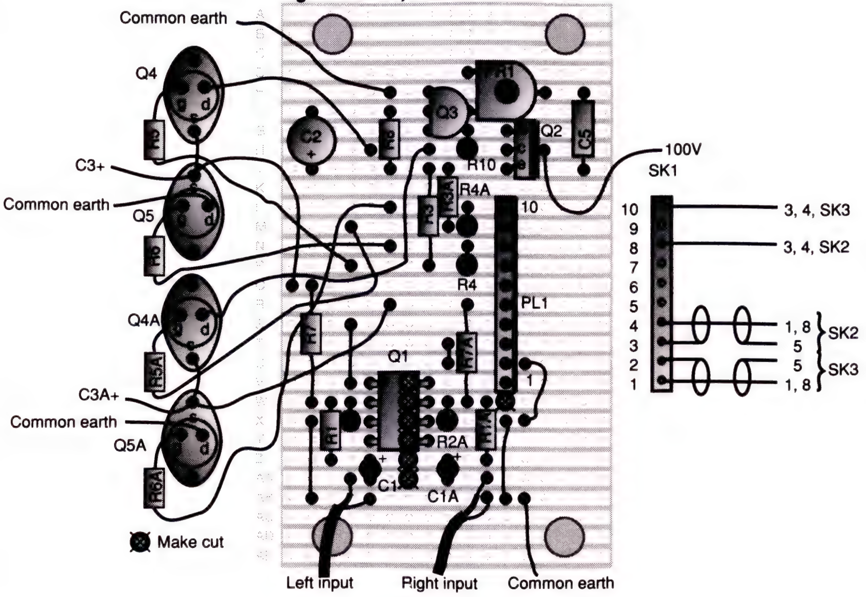
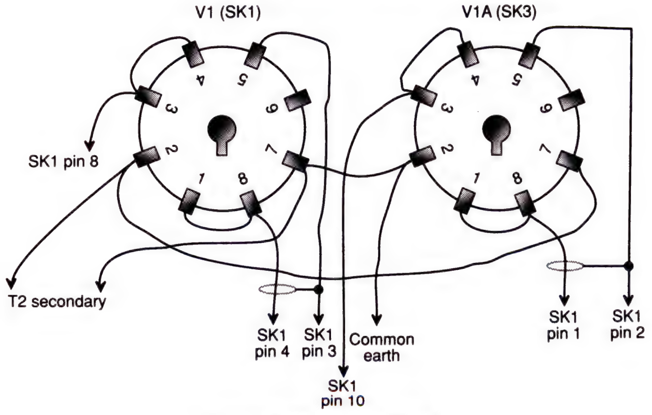
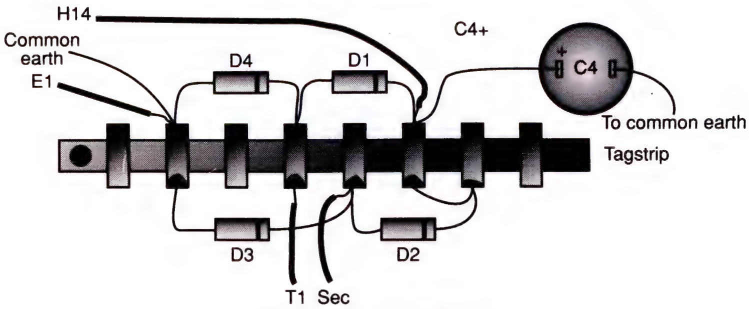


Fig.6. Stripboard layout.



Valve base connections.



Tagstrip connections.

C1 simply acts as a DC block for input signals while providing a short circuit at audio frequencies.

Having described the main amplifier circuitry in outline there are some practical aspects which also need attention. Because we are using a valve as one of the active elements it follows that it will be some seconds before this device switches on. It takes time for the heater to reach operating temperature and this has serious consequences for the speaker.

If no special precautions are taken, the full line voltage would find its way onto Q4's gate. This would switch hard on and C3, be initially discharged, would pass an enormous current pulse to the speaker. With 100V on the line and an 8Ω load, theoretically a 12.5A pulse would be coupled into the speaker. This is obviously undesirable and some method must be devised to prevent it occurring.

The solution is to supply the line voltage to the driver stage gradually. This is the purpose of Q2, Q3 and the associated circuitry. At switch on C2 is discharged and appears as a short circuit between Q2's emitter and Q3's base. The voltage across it rises until prevented by Q3s base and R8. The Q2 darlington pair emitter follower is supplied with base current by R10. As C2 charges, the voltage across R8 and at the emitter of Q2 rises gently. By the time this voltage has risen to near its final value it has reached its operating level.

One slow start circuit is required to power both channels. What isn't apparent from the circuit diagram is the hidden function of the circuit. It operates as a super smooth supply for the driver circuitry and isolates the performance of the amplifier from the rest of the power supply. It has a performance comparable to a 317 regulator chip.

Turning to the other end of the circuit, the power supply. This falls naturally into two parts. T1 is the main transformer which, for reasons of compactness and low external magnetic field, is a toriodal component. The secondary voltage is full wave rectified by D1 and D4 and applied to the main smoothing capacitor C4.

T2 is a 6V secondary transformer rated at 4A and supplies the heater voltage for the valves. Each of these takes over one amp of current and

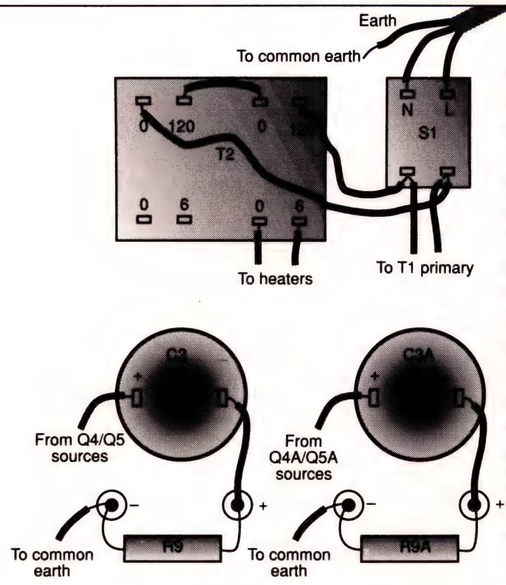


Fig. 6. cont.
- **Mount R5/6/5A/6A directly on the gate pins of Q5/6/5A/6A.**
- **Mount tagstrips and veropanel on 0.25in spacers.**
- **All connections marked common earth are taken to a point on the chassis.**
- **PL1/SK1 are 10 way PCB mounted plug and mating socket.**
- **Screened lead is used for connections between SK1 and grid/cathode connections.**

would be a logistical nightmare with regulated DC. Thankfully this is not required. There is no audible hum from the circuit using pure AC provided that the wiring diagram is properly followed. Note especially that one end of the heater circuit is connected to common earth.

Despite the fact that valve heaters are usually specified at 6.3VAC slightly underunning them extends valve life and has little effect on performance.

Building It

Originally a low profile case was to be used with this project. However, getting a ready built case proved impossible. The custom case is made from 2mm aluminium sheet and sections of aluminium channel for the end and side pieces.

Fig. 5. shows the dimensions of the case panels together with the cutout positions. A 10 way PCB connector is used to connect the board, valve-holders and power supply.

Connect the output stage flying leads to the VFETs as shown and make sure that these power devices sit flush against the heatsink. Ensure that there is no electrical connection between the heatsink and the case.

A thin piece of screened lead is used to connect the cathode and grids to the board whilst the other wires are simply hookup cable. First order of business is to mount the board on the bottom panel of the case. Set this aside and complete the panel wiring. The heater wires are required to carry a considerable current continuously and so, 5A twin speaker wire are used. There is no need to twist these wires together, simply run them close to the chassis.

Having finished the panel wiring, check the work thoroughly and then connect the rest of the flying leads to the points shown apart from the line from the tagstrip to H14, and attach the PCB connectors.

Setting Up

Before testing the device it is as well to take a few safety precautions. First, put insulating tape across all mains connections including the primary of T2. Double check all the wiring and temporarily disconnect the earth wire from the main plug. Set the slider of PR1 at halfway. Now connect a 100Ω resistor between the plus terminal of C4 and the drains of Q4/4A. Connect a multimeter, switched to a voltage range which will clearly show 100VDC, between ground and Q2's emitter.

Switch the circuit on. The voltage should gently rise to a maximum set by PR3. If this doesn't occur, or worse, the 100Ω starts to smoke, switch off immediately. You have a wiring fault. Assuming that all is well, slowly adjust PR1 or 95VDC. The voltage will continue to rise after any adjustment so it needs to be done slowly.

The valve heaters should begin to glow a few seconds after switch on. Measure the voltage at the sources of Q4/5 and the other channel Q4A/5A. This should measure around 55V. A couple of volts either way is of no consequence. Assuming all is well, remove the 100Ω resistor and replace it with a wire link and the amplifier is now functional. All that remains is to screw the case together and test it out with some music.

The sensitivity of the amplifier, for full output, is some 500mV. This can be easily obtained from almost any preamp. If you have a CD system, the amplifier can be used via a passive preamp – simply a potentiometer arranged as a potential divider will do. Any loudspeakers rated at 80W and up can be used with the amp including 4Ω types although the output level will be reduced. ■

Components

Resistors

1% metal film unless indicated.

R1	27k
R2	15k
R3	8k2
R4	150
R5, R6	220
R7	1M
R8*	150k
R9	100
R10	150k
PR1*	10k horz preset min
Capacitors	
C1	10µ/16V
C2*	100µ/100V
C3,C4*	4700µ/100V
C5*	100n/250V
Active devices	
Q1	SSM2210
Q2*	BDV65C
Q3*	MPSA42
Q4	2SK135
Q5	2SJ50
V1	6CA7
D1, D2, D3, D4	1N5404

Miscellaneous

T1* 240VAC pri, 35-0-35V sec 160VA transformer
T2* 6-0-6V, 4A sec
2xOctal sockets
2x10mm grommets
4x4mm bannana sockets
4xlarge self adheisive feet
1x6mm P clip
1*xDPST mains switch
1x10 way PCB mounted plug and mating socket
24x10mm no 8 self tapping screws, case, PCB or stripboard
1x8 way tag strip.

* devices common to both channels.
Note that these are for one channel only. Channel 2 components are indicated in the diagrams with an A suffix.
A full kit of parts can be obtained from: Hobtek, The Cottage, 8 Bartholomews, Brighton, East Sussex, BN1 1HG for £189+£5p&p.

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The Summer Consumer Electronics Show

Ian Burley touches the new Sony Mini-Disk, takes control with SIRCS II, examines the latest in multi-media all while dodging the security robots in Chicago.

The twice-yearly US Consumer Electronics Shows, which alternate between Las Vegas (winter) and Chicago (Summer), are a highlight of the electronics calendar.

The latest show in Chicago certainly lived up to expectations. Among the notable new products this year was a first-look at the Sony Mini Disk (MD). Sony also previewed SIRCS II, its intelligent networking system for Hi-Fi and video units. Philips officially launched its domestic CD-I multimedia player, Sharp exhibited the first wall-hanging flat-panel LCD colour TVs and Samsung had a domestic robot on show, to name but a few of the attractions.

Sony pulled off the impressive feat of being the star of CES without actually having a show-floor exhibit. Instead, it rented a plush suite at a nearby hotel to show, in a more intimate atmosphere, its MD player alongside an improved version of last year's star Sony CD innovation – the Data DiskMan electronic book.

Reading about the MD is one thing. Giving a working one (even a prototype) a shake while it is playing is another. The 1Mbit anti-skip buffer memory really works. In fact, it is possible to eject the 2.5in MO (magneto-optical) disk with perfect playback continuing for about three seconds afterwards. If the price is right when the MD goes on sale at the end of next year, joggers will be queuing up for one of Sony's new babies. Unfortunately, we weren't treated to a demonstration of the MD-player's recording capabilities. Apparently the prototype isn't quite ready to do that in public yet. However, playback quality from sample pre-recorded disks sounded fine.

The New CD-I player from Philips includes Bitstream CD Audio and Photo CD compatibility.

Some of the exhibitors at the Chicago CES

Meanwhile, Philip's show-stopper from the Winter CES in January, DCC (digital compact cassette) didn't make a big public showing this time. A futuristic Memorex ghetto-blaster mock-up based around a DCC player was the only show-floor evidence of DCC I spotted, however behind the scenes plenty of support emerged for DCC.

Matsushita (Technics and Panasonic brands) now publicly admits it is the major Japanese backer of DCC. Even Sony has indicated it is seriously researching the possibility of producing DCC-based products even though this could be at the expense of its own DAT (digital audio tape) standard. The major German tape manufacturer, BASF as well as the Tandy Corporation were yet more big names to pledge support for DCC.

The future for personal digital audio is now becoming a bit less confused. DAT looks destined to be restricted to the big-spending hifi perfectionist as well as professional studios and even computer storage applications. MD will fit in the middle as a not exactly cheap recording medium at about a tenner for blank 74 minute MO disks, but will be attractive for its shock-proofing, compact dimensions and random track access features. DCC really does look like fulfilling Philips' strategy of replacing the venerable compact cassette as the every day affordable digital recording medium.

Sony wasn't content to sit on its Mini Disk laurels at the show and followed up the MD marvel with an innovation we'll surely be seeing a lot more of in the future; intelligent and automatic interaction between hifi and video components. This is SIRCS II, the MkII Sony Infra Red Control System. SIRCS originally came about in the early 80s when Sony decided to standardise its infra-red remote controllers. This enabled a single remote to be used with several different units, say an amplifier, CD player and the TV or VCR. SIRCS II is a bit of a misnomer as the infra-red aspect takes a back seat to computer-style networking. At the heart of the system is a remarkably small custom IC developed by Sony to provide intelligent inter-component control.

A SIRCS II set up sees all your Sony Hi-Fi, video and TV components linked up by wires with 3.5mm stereo jack connectors. Insert a video into your VCR and not only will the VCR switch itself on, but it will alert the TV and even the Hi-Fi amplifier, if fitted. When you get bored with the video and press play on your CD remote. The Video section of the system will go to sleep – unless it's recording, in which case the TV will switch off but the VCR will remain unaffected. Audio tape sections have similar priorities when in record mode, so if you're recording off a radio tuner this will remain unaffected by the system being prompted to play your laser video disk. What's more, if you try to play, say your CD and there's no disk loaded, the TV will light up with a polite message informing you of the situation.

SIRCS II was demonstrated to a fascinated audience at the Sony hotel suite. Apparently, all Sony's up-market Hi-Fi will have SIRCS II capability as standard quite soon. Whether it's a genuine step forward in home automation or a rather sophisticated gimmick, remains to be seen. No doubt the Hi-Fi purists will reject it out of hand. Unfortunately, Sony isn't offering its SIRCS II technology to anybody else, so inter-make compatibility will be a problem when the competition eventually catches up. JVC exhibited a simpler intelligent components system for its VCR systems called AV Compulink and Bang and Olufsen has been selling an infra-red link system for its Hi-Fi components for some time, though this isn't nearly as advanced as Sony's. Although admitting that an extension of SIRCS II to other household appliances and even a personal computer was technically feasible, Sony won't be producing anything like this in the near future, if ever.

The Pioneer CLD-M90 multi-play CD/Laserdisk player.

Enough of Sony and on to Samsung, the huge Korean electronics firm. Not usually noted for its innovation, Samsung surprised many at CES with its new domestic robot called Scout-About. This is a dome-shaped device weighing 16lbs and about ten inches high which scuttles about on wheels. It's a bit like the top of a Dalek! Scout -Abouts aren't designed to bring you your slippers or a cocktail, instead they're seen as a robot replacement for the household pet come guard dog. A battery of sensors in the robot makes it a mobile fire and intruder detector. Scout-About can communicate with a static base-unit to call the police or fire service, if necessary, speaking in a pre-recorded digitised voice. The idea is that you position your Scout-About in the middle of a room, which it will patrol up to a radius of thirty feet. Scout-Abouts won't fall over edges like stairs and another sensor prevents collisions with obstacles lower than 2 feet. Battery charge life is 50 hours and the unit can be used in a static position with an AC adaptor. At an estimated selling price of $1,000 (£625), the Samsung Scout-About is set to be a hot seller in US department stores this Christmas.

Philips has finally done it. Almost five years since its introduction and after countless delays, Compact Disk-Interactive (CD-I) has been launched as a consumer product at last – though in the States only. The European launch won't be until Spring next year. Under Philips' Magnavox brand name, the first consumer CD-I player will be on shop shelves in October for the recommended price of $1400 (£875). That's considerably more expensive than Commodore's rival CDTV system ($1000) which is based on Commodore Amiga computer internals. However, CD-I is technically superior and it has the backing of industry heavyweights like Matsushita and video-game leaders Nintendo. Those facts alone rated it as most likely to succeed according to many show-visitors . The fact that Nintendo has jumped onto the CD-I bandwagon was a great fillip for Philips if you'll pardon the pun. Nintendo, which controls a multi-billion dollar video game empire, ditched a rival CD-multimedia development with Sony called Playstation by switching allegiance to CD-I. Another plus for CD-I is that Kodak's Photo CD standard is to be added to the CD-I specification. CD-I full-screen motion picture video is not yet

The Samsung Security Robot.

Sharp's RE-F1 fuzzy logic microwave oven cooks, weighs, stirs, kneads and mashes a meal in under 15min using artificial intelligence.

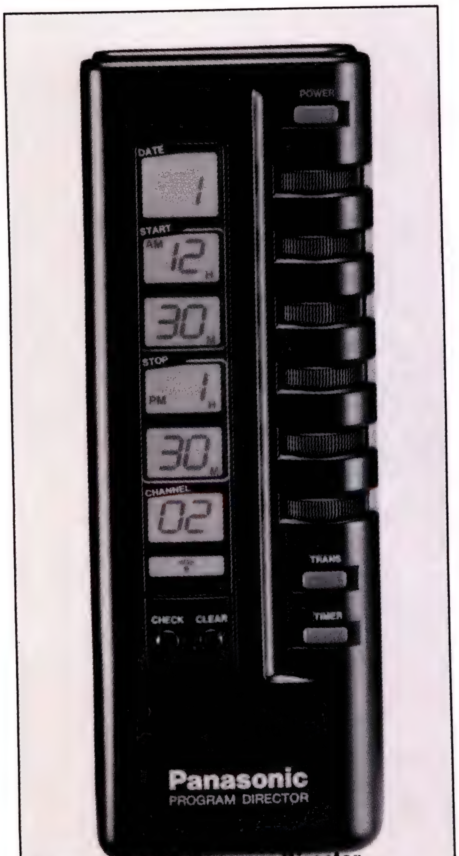
ready, which is partly why the European launch has been delayed, but upgrades will be available to initial CD-I buyers in the States hopefully early next year.

Commodore started shipping their CDTV system six months late in May. It has more software out now than Philips, but it will never be able to match the specially developed CD-I hardware for motion video playback quality. In fact some of Commodore's partial-screen motion video demonstrations at the show were decidedly grotty. After the show opened, Commodore announced that Kodak Photo CD compatibility would also be added to the CDTV spec. but this was soon countered by a statement from Kodak questioning if this was technically possible without a major hardware redesign of the CDTV. CES saw just the first of several major battles to come between CDTV and CD-I in the war to find a consumer multimedia victor...

Sharp's latest wall hanging flat screen LCD TVs with their tasteful designer frames.

NEC had a tiny corner of its video-game exhibit showing something far more interesting than any PC-Engine or TurboGrafx console. Here I stumbled across NEC's NID, which stands for New Interactive Display. Yes, this is another entrant in the CD ROM-based multimedia race but so far the only one to display a working full-screen motion video system destined for a consumer product and vastly superior looking to Intel's DVI (digital video interactive) full-screen video.

NID has an incredible 100:1 compression ratio using techniques similar to those of enhanced definition TV (Pal Plus for example). Only parts of the screen which change are digitally captured and portions of the screen which exhibit movement over a certain threshold are digitised in space-saving lower resolution – the human eye can't tell the difference. The result was very impressive, despite some odd colours produced by prototype hardware which was slightly damaged en route from Japan. NID will offer up to 72 minutes of continuous motion video at a resolution of 256x240 pixels as well as a stereo sound track. Exactly where NID will end up as a commercial product remains to be seen.



Panasonic LCD Program Director.

As for the rest of the show, JVC had a massive 36in diagonal 16:9 aspect ratio TV set, similar in appearance to a wide-screen HDTV. However, this was a decidedly below-average resolution standard 525 line NTSC tube. Why wide-screen? To get rid of the pillar box effect of cinemascope-style movies of course. In ordinary TV mode the spare picture space is used for viewing other channels simultaneously in miniature.

Sharp got the vote for the least taste award at CES. Apparently there is a sizeable market in Japan for its impressive range of ever larger active matrix colour LCD screens, used as wall hanging TVs. So what? To hang an LCD on the wall, you need to put it in a picture frame according to Sharp – and you should have seen some of the frames they're offering.

Panasonic might have at last solved the seemingly insurmountable problem of designing a infra-red remote control which even Mensa members can figure out how to use. Panasonic's Program Director dispenses with buttons and incorporates thumb-wheels instead. It's a brilliant idea and should have been thought of ages ago.

Finally, how about using the mains electricity wiring in your home as a telephone extension? The Utah-based firm, Phonex, has done just that. Using the mains for intercoms and even computer networks is old hat, but this is the first time I've seen a cordless phone extension system like this. The advantages are obvious: no excessive REN (ringer equivalence number) loading and a phone socket in every room. A mains extension cable becomes a phone extension! Range is said to be 1000 feet. The problem of neighbours listening in to your calls is apparently solved by an attenuator at the electricity meter. Future plans include a security encoded link and a UK version for BABT approval. ■

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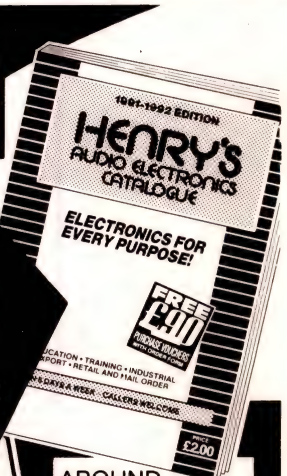
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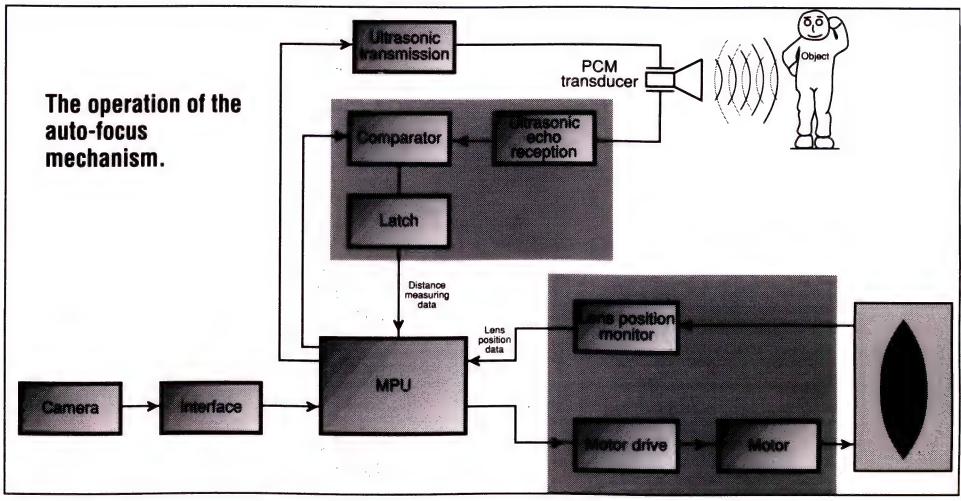
How It Works...
The Video Camera

Derek Gooding zooms around inside a video camera and describes the operation of the various circuits.


The operation of the auto-focus mechanism.

Incoming light reaches the surface of the integrated stripe filter after passing through the automatic iris control lens (AIC), the colour trmperature conversion filter (for artificial light or sunlight conditions variation) and finally through the crystal filter.

The white balance switch inserts a diffusion filter in the light path between the automatic iris control lens and the colour conversion filter to enable a computation of "white" diffused light in the available illumination.

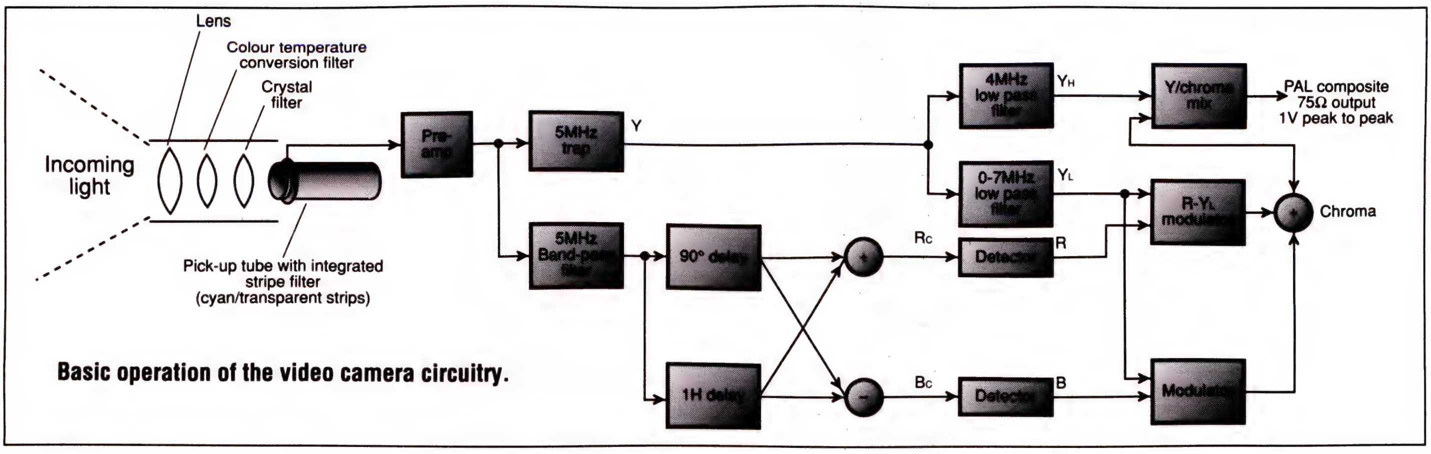
The crystal filter helps to eliminate any false interference patterns when fine detail is viewed.

The stripe filter converts the incoming light into a 5MHz modulated signal containing the red and blue components and the green signal.

The pre-amp takes the pick-up tube signal (0.2μA to 0.3μA) and amplifies it for delivery to to the signal processing circuits using a low output impedence and negative feedback low noise FET input amplifier with a "Percival" low noise circuit to improve the signal to noise ratio for the relatively high frequencies. Only the luminance (Y) signal passes through the 5MHz trap together with the mean value of red and blue signals (modulated). The Y signal passes to the 4MHz and the 0.7MHz low pass filters. The high frequency response (Y_H) passes to the Y/chroma mix circuit and the low frequency (Y_L) signal to the R-Y_L and B-Y_L modulator circuitry.

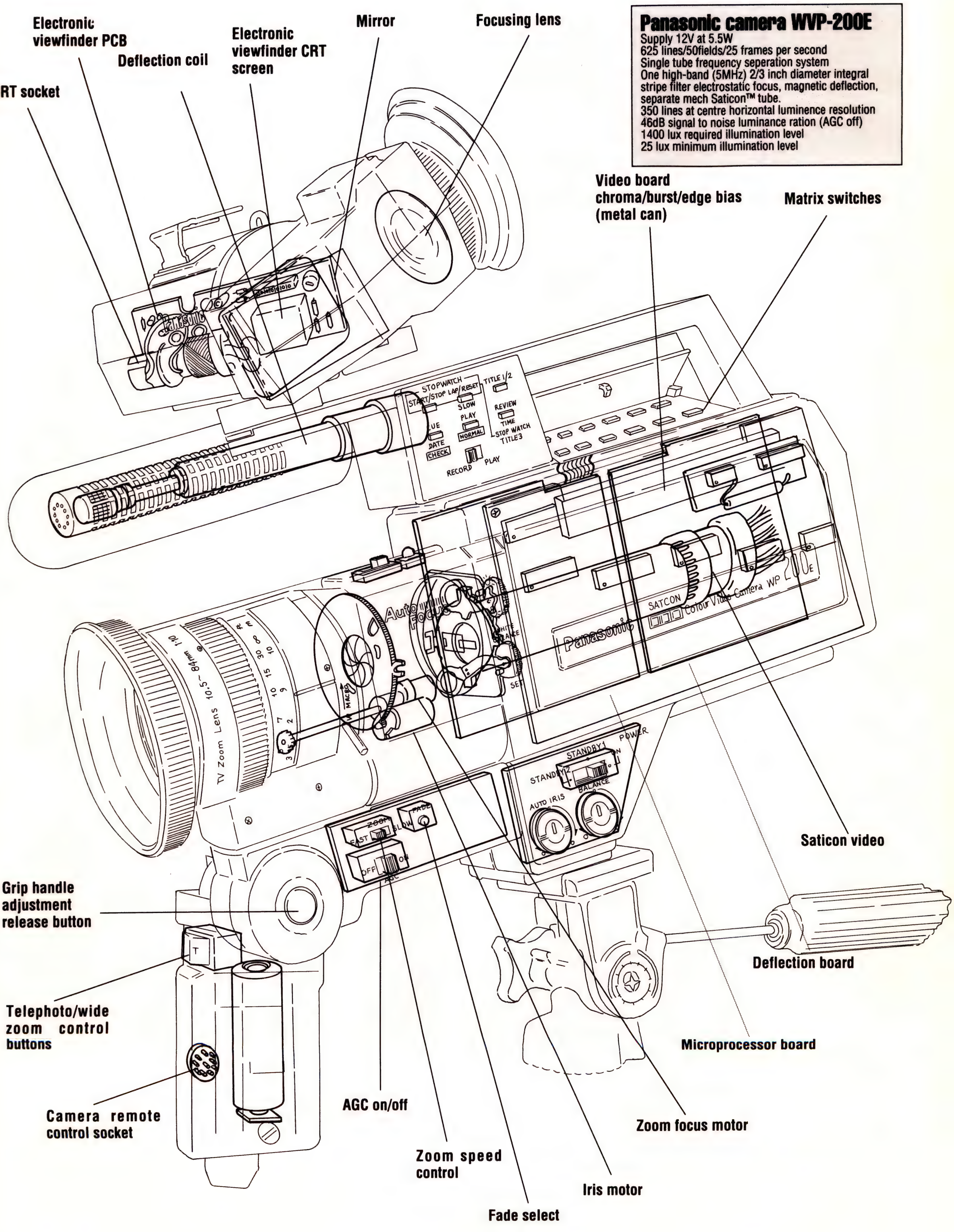
The 5MHz band pass filter allows only the 5MHz frequency zone to pass to the 90° phase shift and 1H delay circuity – inverting the 1H delayed modulated signal and adding it to the 90° delayed signal creates the R_C signal and subtracting the inverted 1H-delayed modulated signal from the 90° delay signal creates the B_C signal. The detector circuits provide the modulators with the R-Y_L and the B-Y_L signals to create the chrominance (chroma) signal, by mixing.

The PAL signal composite is created by mixing the chroma signal with the luminance (Y_H) signal.


Basic operation of the video camera circuitry.

Panasonic camera WVP-200E

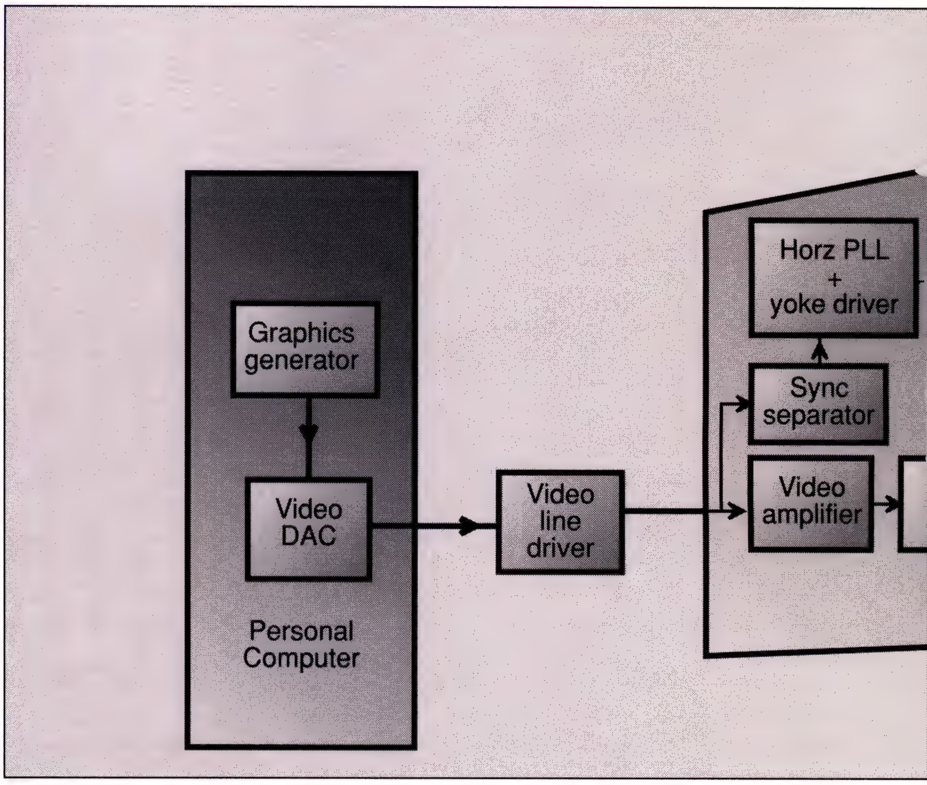
Supply 12V at 5.5W
625 lines/50fields/25 frames per second
Single tube frequency seperation system
One high-band (5MHz) 2/3 inch diameter integral stripe filter electrostatic focus, magnetic deflection, separate mech Saticon™ tube.
350 lines at centre horizontal luminence resolution
46dB signal to noise luminance ration (AGC off)
1400 lux required illumination level
25 lux minimum illumination level



The demand for increased monitor resolution for use in Desktop Publishing, CAD and other graphics applications has lead National Semiconductor to develop some specialised video driver chips. Amongst them are the LH2426 and LM1201. The first is a triple 80MHz driver which can provide the red, green and blue signals directly to a cathode ray tube (CRT). The second is a wideband video amplifier which contains a brightness control and DC restoration voltage for the video signal.

Many modern computers provide analogue video output signals that allow access to a large range of colours or grey scale. These signals usually come from a digital to analogue convertor (DAC) controlled by a graphics processor within the computer. In the monitor these signals have to be amplified and conditioned from the 1V peak to peak (pp) of the computer to the 40Vpp needed to drive the cathode of the CRT.

The monitor's operation is split into two main sections, a low voltage video amplifier and a high voltage CRT driver. Each pixel of the display has to be energised by a varying amplitude pulse in a time that depends on the resolution. The higher the resolution, the shorter the pixel time and the wider the bandwidth needed. The popular monitor standards and resolutions are shown in table 1. These start at the basic 600x400 VGA PC and go up to the workstation 1280x1024 pixels. The corresponding pixel times for each system is also shown along with the overall rise and fall time for the video channels. There is no hard and fast rule for these times and they can vary between 1/3 and 1/2 of the pixel time depending on performance requirements.



A single complete channel is shown in Fig. 1 with independent adjustment for contrast and brightness included. For the latter, the voltage from the brightness control is sampled by the clamp comparator at the beginning of every line and the use of a feedback loop forces the DC voltage at the cathode to be at the level set by the black level adjust. The clamp comparator is controlled by the back porch pulse derived from the line sync pulse and occurs during the black level reference period of the video waveform.

LH2426

This chip contains three wide bandwidth, large signal amplifiers each designed for large voltage swings at high frequencies. The amplifiers work on a transconductance principle – an input current swing of ±4.38mA results in an output voltage swing of ±25V. Features include:

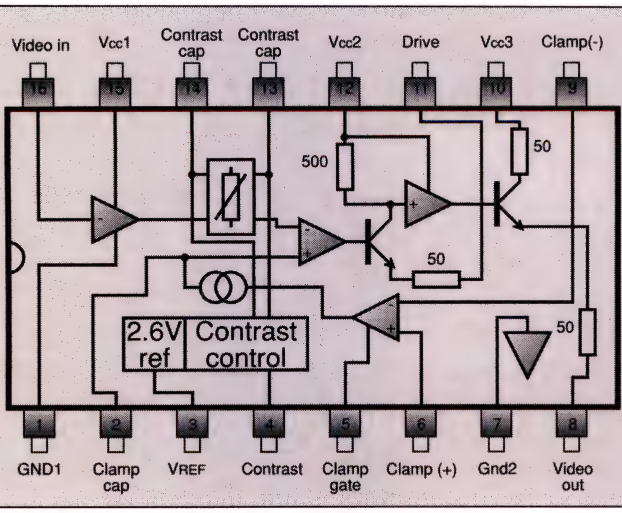
- Operation from an 80V pow supply
- 80MHz bandwidth at 50Vpp swin
- Rise fall time of less than 4ns.
- Output signal swing of 70V.
- Drives a CRT directly.

LM1201

Designed for use with high resolut RGB or monochrome moni applications, this wideband vi amplifier has a number of features t help reduce chip count.

The chip contains a ga differential input black level cla comparator for brightness control a an attenuator circuit for contr control. The main features of circuit are:

- 200MHz @-3dB wideband amplifi
- Attenuator circuit for contr control.



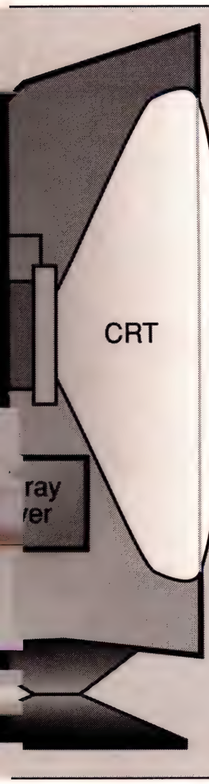
Operational Ratings

LM1201

Supply voltage Vcc, Pins 10, 12, 15, to gnd pins 1, 7	12V
Max voltage at any input pin	Vcc
Video output current	28mA
Power dissipation	1.56W
Operating temperature range	0°C to 70°C

LH2426

Supply voltage	+80V
Power dissipation	10W
Operating temperature range	-20°C to +90°C



Externally gated comparator for brightness control.

Provisions for external gain and peaking of video amplifier.

Video input voltage reference.

Low impedance output driver.

Also available is the LM1203, a iple version of the 1201, which is esigned for use with resolutions up to 024 x 768 and RGB. ■

Monitor Standards

System	Resolution	Chip set	Pixel time	Rise and fall time
VGA	640x480	LM1203+LM2416CT	42ns	21 - 14ns
Super VGA	800x600	LM1203+LM2416T	29ns	14.5 - 9.6ns
8514/A interlaced	1024x768		22ns	11 - 7.3ns
PC-CAD non-interlaced	1024x768	LM1203+3xP43+LH2426	16ns	8 - 5.3ns
Work Station	1024x900	3x(LM1201+P43)+LH2426	14ns	7 - 4.6
Work Station	1024x1024	LH2440, LH2422	12ns	6 - 4ns
Work Station	1280x1024	LH2440A, LH2424, LH3424	9.8ns	4.3 - 3.3ns

P43 is a process 43 transistor 2N5770 or PN2564

Table 1.

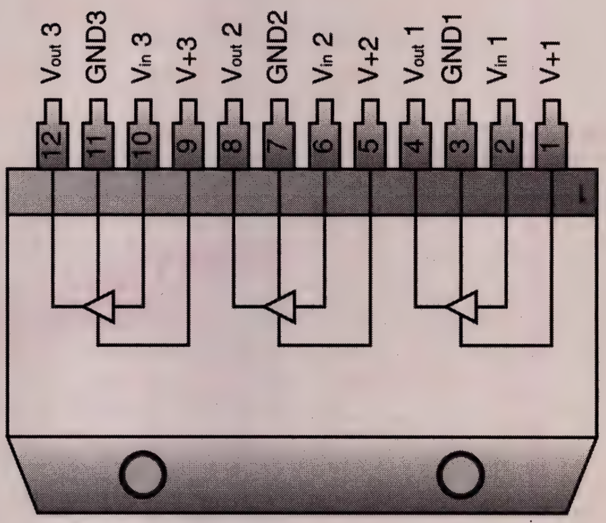
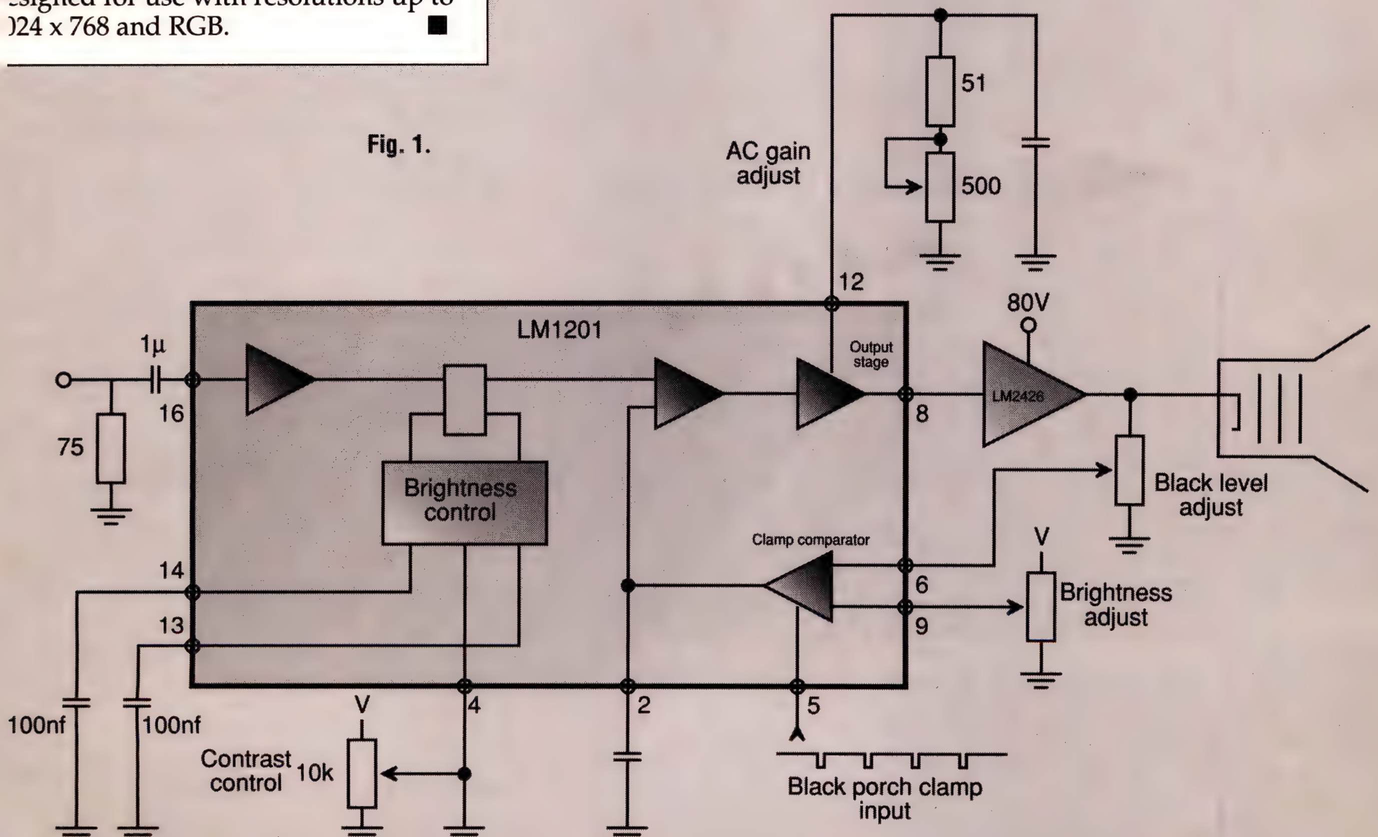


Fig. 1.



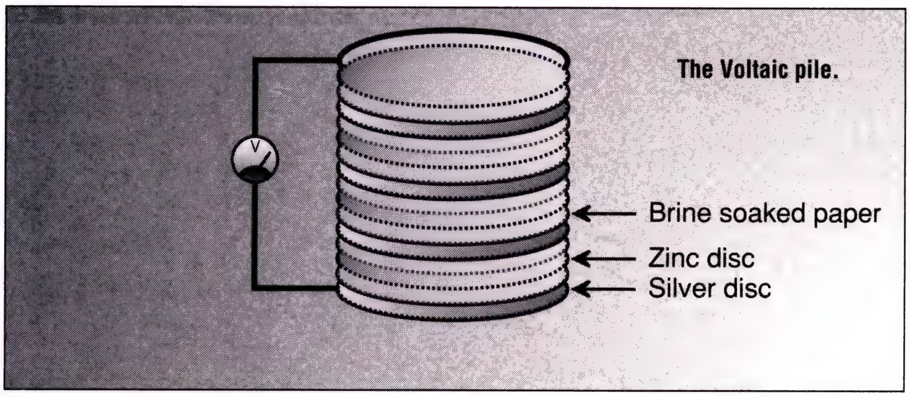
Practical Components. The Battery

Batteries are an indispensable part, necessary to all portable electronic equipment. This month's components looks at the variety available.

Invented around 200 years ago, the battery has become a vital part of modern mobile electronics. The first battery was a stack of zinc and silver coins separated by discs of paper soaked in brine. It was invented by Alessandro Volta who eventually gave his name to the unit of electromotive force, the Volt.

Batteries come in two main types, primary and secondary. The first are one-shot and an irreversible chemical reaction produces the energy. These are the most common types but are gradually being replaced by secondary or rechargeable cells. The most commonly used of these are lead acid and nickel cadmium.

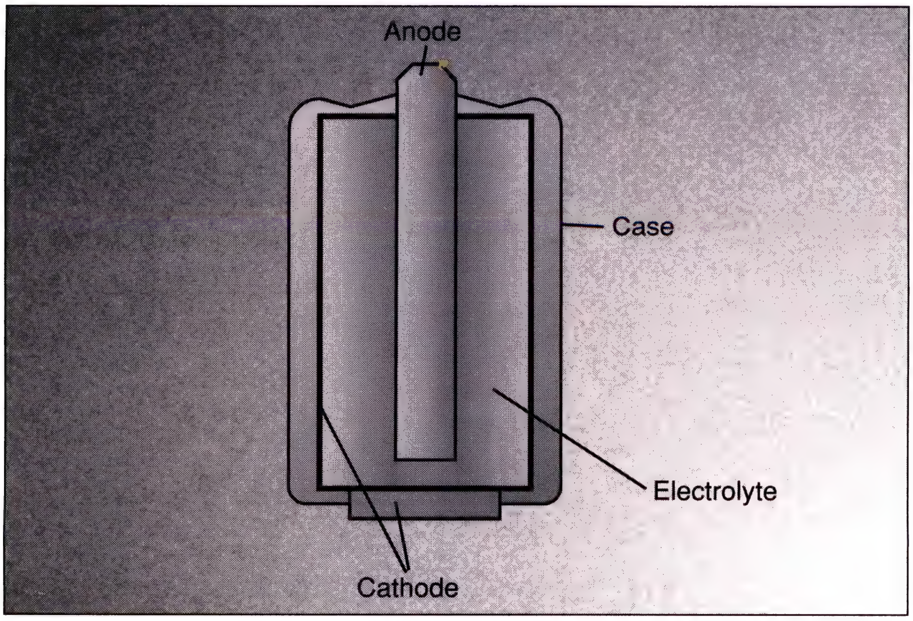
Another device that can be classed as a battery is the solar cell. This makes use of the photo-electric effect in a semiconductor. When the junction of two differently doped pieces of semiconductor have light shone on them, electrons are liberated causing a a small voltage to be generated. Solar cells have to be placed in series and parallel to provide energy in workable quantities.


The Voltaic pile.

Elements Of A Battery

A battery is made up from a series of cells connected in either series or parallel to increase the resulting voltage or current. The main features are:

- The electrodes, the anode and cathode, which also form the electrical contacts
- The electrolyte which allows the movement of electrons from cathode to anode and aids the chemical reaction
- The case, which may be sealed to prevent leakage or open to allow gases to escape

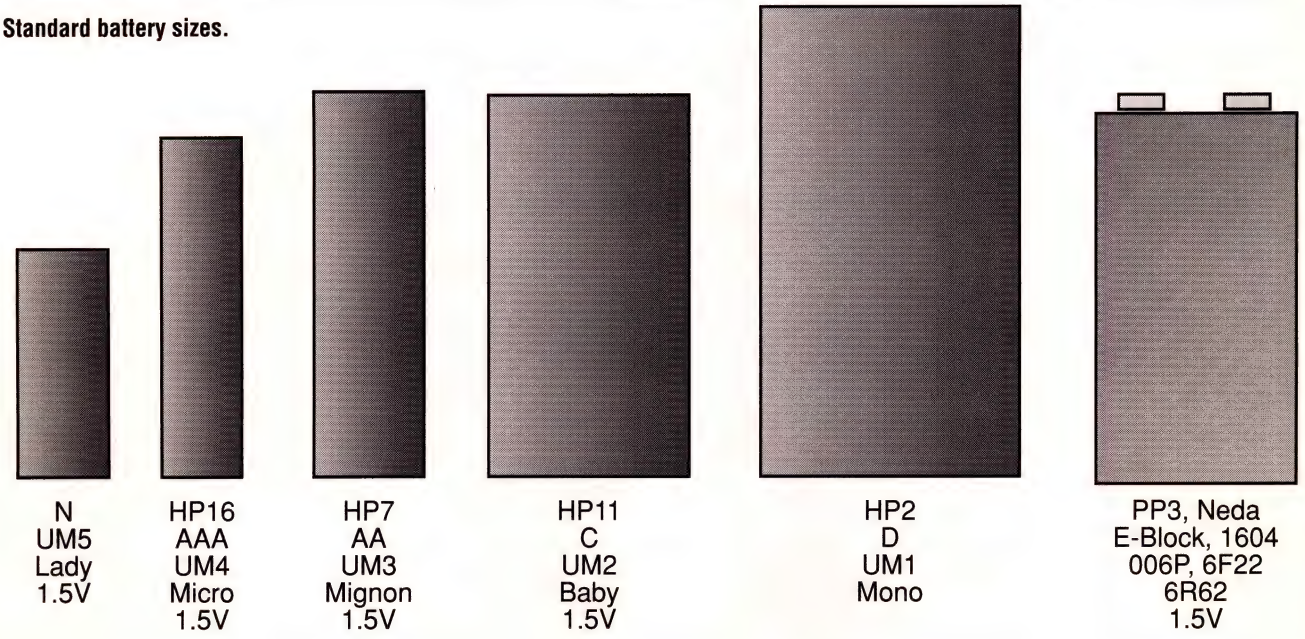


Recharging

The most popular rechargeable batteries are on the lead acid and nickel cadmium types. The first are used mainly in cars and are generally quite bulky. NiCd's, on the other hand, offer direct replacements for all of the standard sizes used in modern portable electronic equipment.

Charging up a NiCd is not simply a matter of connecting it up to a source of power. A constant current source must be used giving 45mA at the correct cell voltage of around 1.55V. For a faster charge, 150mA current can be used but this reduces the discharge time – the longer it takes to charge a battery, the longer it lasts. ■

Standard battery sizes.



Battery types

Zinc carbon or Leclanché cell.
Commonly found in torches, transistor radios and other relatively short term applications, the zinc carbon cell cannot be recharged. It has a zinc cathode and a carbon anode with an electrolyte of ammonium chloride paste. A depolariser of manganese dioxide id distributed around the anode and mixed with powdered carbon (graphite) prevents the build up of hydrogen gas. Another name for this type of cell is a dry cell and it produces a voltage of about 1.5 volts.

The Daniell Cell
This has a zinc cathode and a copper anode. These were placed in a jar with a porous pot barrier in the middle. The cathode side was filled with sulphuric acid and the anode with copper sulphate and the electrodes inserted. This operates as follows:

At the cathode a zinc atom gives up two electrons as it enters the cathode electrolyte as a zinc ion Zn2+. This gives the cathode compartment extra charge plus two. To compensate for this two hydroxide ions (H0) with a charge of plus one each pass through the porous separator into the anode compartment. This allows a copper ion to accept two electrons from the anode and deposit itself on the anode as a copper atom. The electrons are made available at the anode because of the external circuit through the load to the cathode

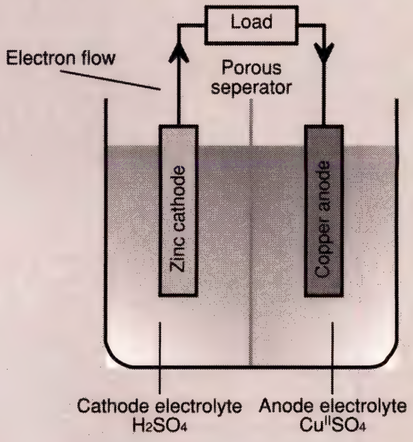
Lead Acid
Most cars have a battery of this type to turn the starter motor to get the engine going. It is made up from two electrodes of lead, one of which is coated in lead IV oxide, dipped into an electrolyte of sulphuric acid. The output voltage from each cell is around 2V so six cells are connected in series to get a 12V car battery with about 90AHrs capacity – it can supply 1A for 90 hours or 90A in one hour. Three cells are put together to make a 6V motorcycle battery.

Nickel Cadmium
NiCd batteries are the mainstay of the modern portable rechargeable battery industry. Available in all the popular sizes, a single cell gives out roughly the same voltage as a zinc carbon cell, 1.25V.

Alkaline
Similar to zinc carbon batteries, alkaline cells offer much longer life at higher current drains. Other advantages are longer shelf life, constant output voltage and protection against leakage.

Mercuric Oxide
Usually found in cameras and hearing aids, these offer an output voltage of 1.35V in a very compact package.

Lithium
Made from lithium manganese these cells have an output voltage of 3V and will last for very long periods at low currents. Applications include battery backup for low power CMOS RAM memories.


Load
Electron flow
Porous seperator
Zinc cathode
Copper anode
Cathode electrolyte H_2SO_4
Anode electrolyte $Cu^{II}SO_4$

The Leclanché Cell.

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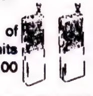

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FM CORDLESS MICROPHONE. Small hand held unit with a 500' range! 2 transmit power levels reqs PP3 battery. Tuneable to any FM receiver. Our price £15 ref 15P42A

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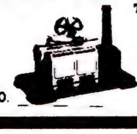

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PE Chronos V
The Main Board

This month Tony Smith looks at the the main board of his universal counter timer with details on hopw to put it together and test it.

Fig. 1 shows a photograph of the completed main board, the component overlay is illustrated in Fig. 2. Begin construction by inserting the through board links and rather than installing them all together, it is a good idea to do them in blocks of 15 to 20 – remember to solder both sides of the board.

Insert the diodes and resistors next, again, soldering leads on both sides of the board. Note that there is a choice between the standard crystal oscillator or a ready built DIL oscillator module to act as the Chronos' timebase. Until the choice is made, all relevant components, XTAL1, R79, R80, R81, C57, C58, C59, C60 and VC4 can be omitted. There is also a choice to be made about C50 and C68 so these should be left out for the moment as well.

Solder all the IC sockets into place and then insert the small capacitors. There are several tantalums and a small electrolytic all of which are polarised and must be inserted the right way around.

It is important to solder several capacitors on both sides of the board, C32, C33, C38, C39, C46, C53 and C56. Many capacitors – particularly disk ceramics – are supplied with pre-formed leads. These kinks should be straightened out before the device is inserted since they add unwanted inductance which can be troublesome, especially where decouplers are concerned.

Next, insert the larger components such as fuseclips, bridge rectifiers, connector plugs and veropins.

Wherever polarised connectors are used in the Chronos, take care that they are inserted so as to match the polarity of their corresponding connectors on the other boards. If this is done correctly, there can be no chance of twisting the interconnecting cables which might otherwise cause considerable circuit damage.

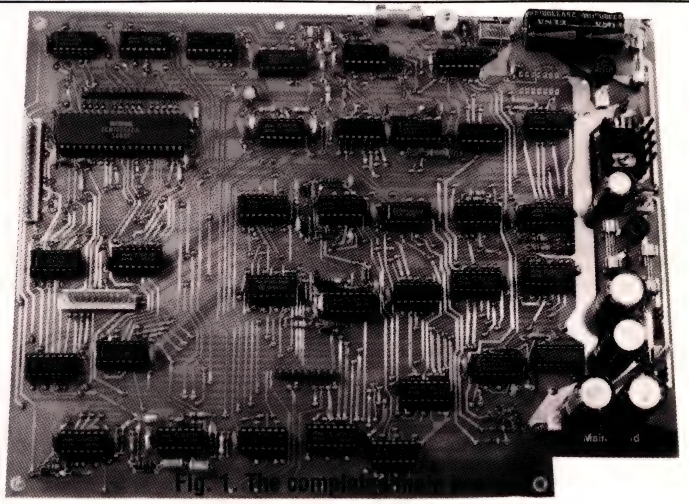


Fig. 1. The complet[illegible]

The 5V regulator, IC33, should now be fixed into place and the heatsink seated before bolting it to the board.

Finally, solder in the six large electrolytics into place (C81, C82, C84, C85, C86 and C87). This concludes construction of the main board. Note that the component leads should be cropped right back so as prevent short circuits.

Power Supply

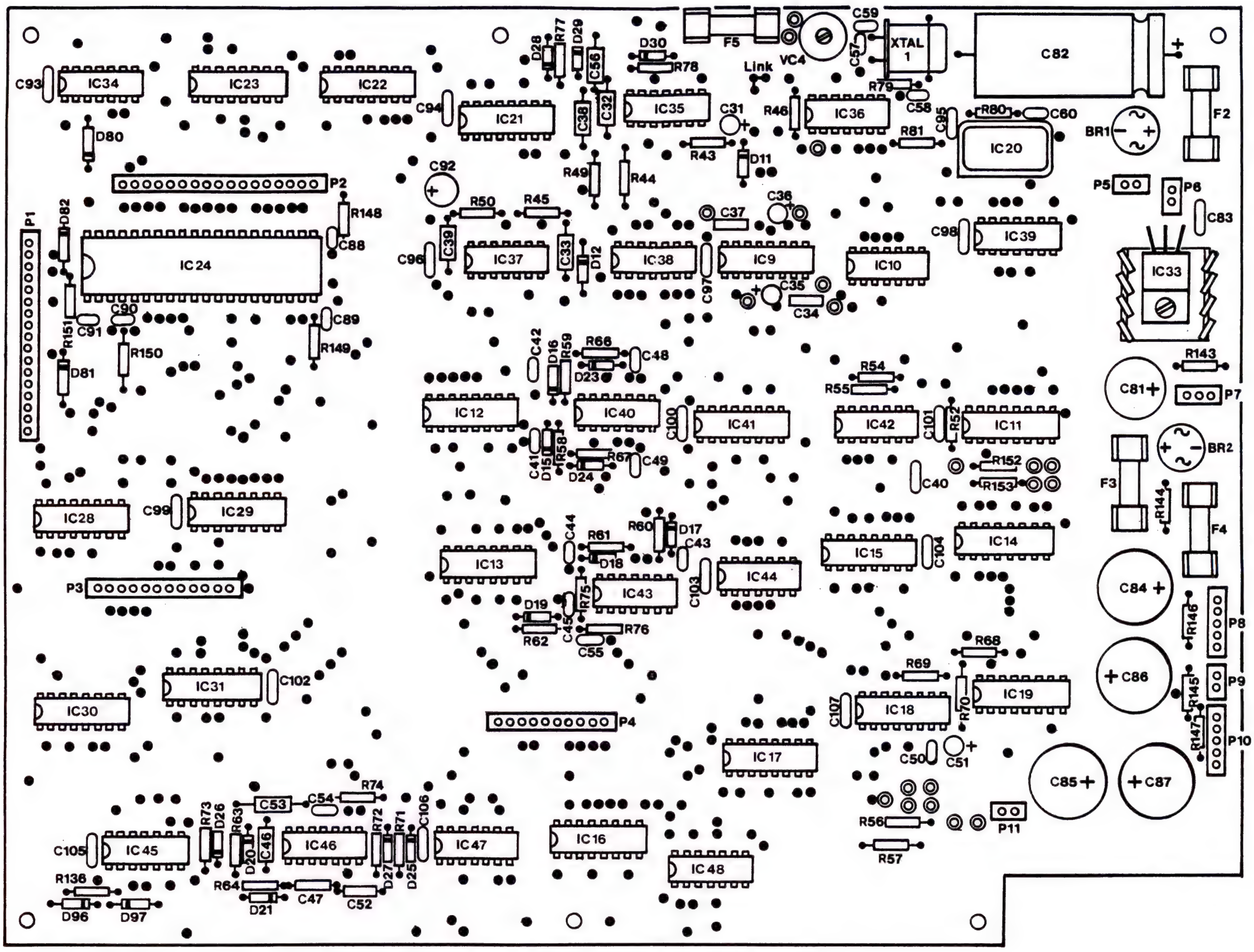
The next step is to connect the transformer secondaries to the main board as in Fig. 3. Temporarily place the rear perpendicular to the top edge of the main board and locate the panel such that the ext. clock BNC socket is directly above the ext. clock input pins marked ①. There is no need to assemble the rest of the case as yet.

Now, take the wires from both transfomer secondaries along the rear panel and bend them out at right angles to the panels so that they pass over the PSU section of the main board. Then, bend them perpendicularly downwards to the relevant connectors and cut to length.

Next, attach the connector sockets to their wires. It is not important which way round the wires from the 9V transformer go, but the centre-tap wire from the 12V transformer must be connected to the innermost terminal (not the centre terminal) of the three-way connector which attaches to the plug P7 (the other wires can go to either of the other two pins).

Insert the anti-surge fuses F2, F3 and F4 on the main board (See Fig. 2) and also the anti-surge fuse F1 in the rear fuseholder and connect the transformer plugs P5 and P7.

The PSU section of the main board is shown in Fig. 4. Transformer T1 provides power for the entire digital circuitry of the



●=Link through board. ◎=Veropin terminal.

Fig. 2. Main board component overlay.

Chronos, whilst T2 drives the split-rail analogue circuits of the main board.

The 9V RMS output of T1 is full-wave rectified by BR1 whose output is smoothed by C82 and C83 such that the input to the 1A 5V regulator IC33 is nominally +10VDC with around 1V of ripple. The output of IC33 is a stabilised 5V DC level having typically 30mV of ripple under heavy load conditions. As well as supplying the digital circuits of the main board, IC33 also provides a separate supply for the input board's trigger LEDs.

The output of BR1 is also filtered by R143 and C81 to provide an unregulated DC supply (nominally +10V) for the 78L05AV, +5V regulators on the input board.

Under full-load conditions, the current taken by the 5V sections is around 400mA. However provision has been made in the PSU design for an auxiliary +5V output to supply extra digital section.

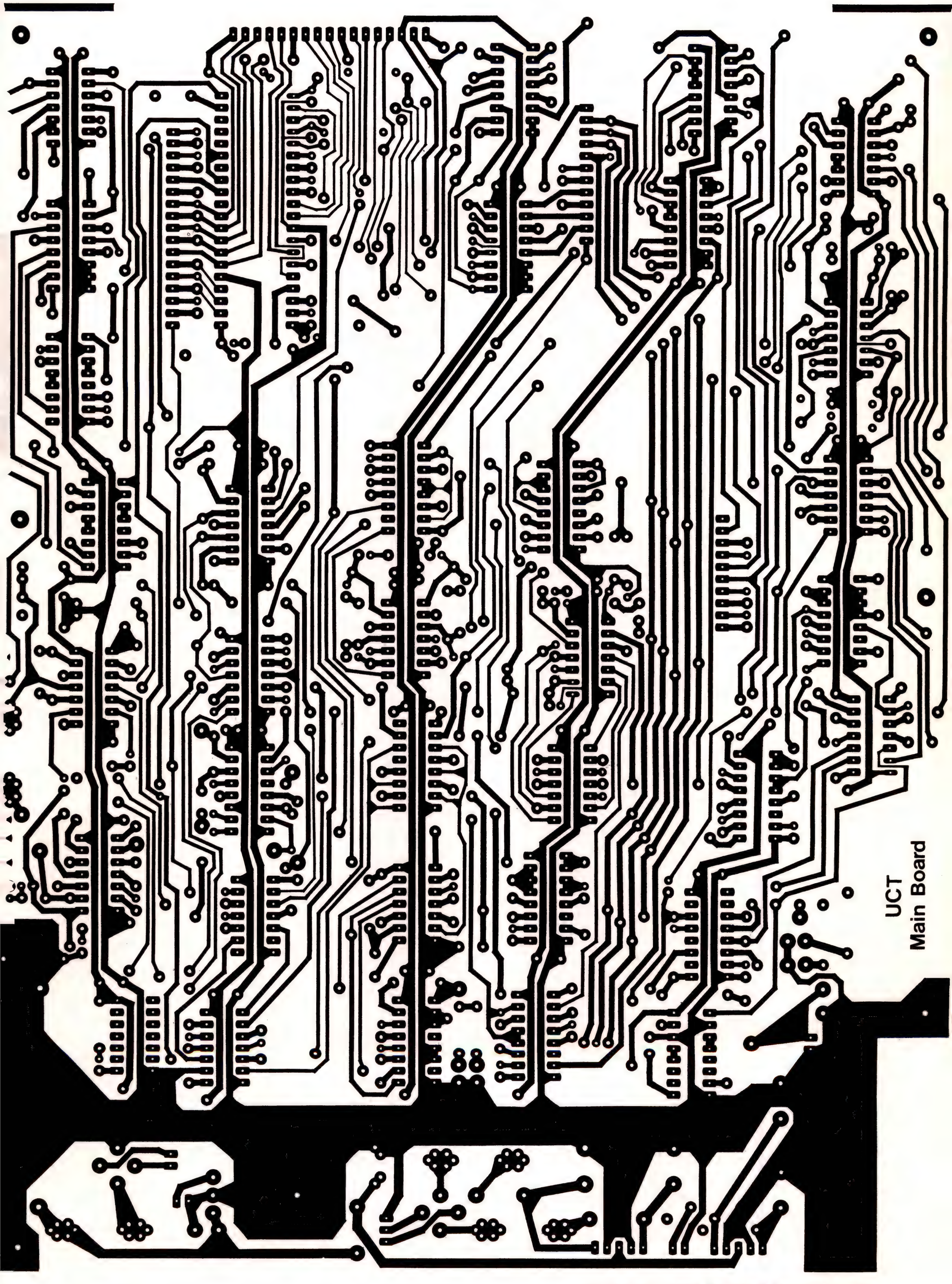
As the auxiliary supply can source around 200mA, the maximum 5V rail current can be as much as 600mA. Thus IC33 must be a 1A device with adequate heatsinking and both the fuse F2 and the secondaries of T1 must be rated at 1A.

The split rail analogue section is referenced to zero volts via the centre tap of T2's secondaries, such that the two 12V windings are each full wave rectified by BR2 providing positive and negative voltages at fuses F3 and F4 respectively. These potentials are smoothed by the RC filters so as to supply each input channel with unregulated DC voltages of ±14V. These are then stabilised by the regulators on the input board, with each rail taking no more than 100mA. Thus, a combined capacity of around 200mA max for the positive and negative supply currents is easily catered for by the 250mA fuses and secondary windings.

The 250V VDR (V1) is fixed across the main supply line to provide the Chronos with protection against excessive mains-bound transients. Under normal conditions, the resistance of V1 is very high and has no effect on the circuit at all. However, should a transient spike greater than the 250V clamping voltage of V1 appear on the lines, the resistance of V1 drops dramatically shunting the transient and absorbing the energy. If a series of excessive transients should appear the fuse F1 is likely to be blown providing protection against further damage.

Testing The PSU

Connect mains power to the main input socket and turn on S18 WARNING: MAINS VOLTAGES CAN BE LETHAL. Take care not to touch any live terminals on the rear panel. Note that no ICs should be inserted yet or the input board connected up via plugs P8, P9 and P10.


UCT
Main Board

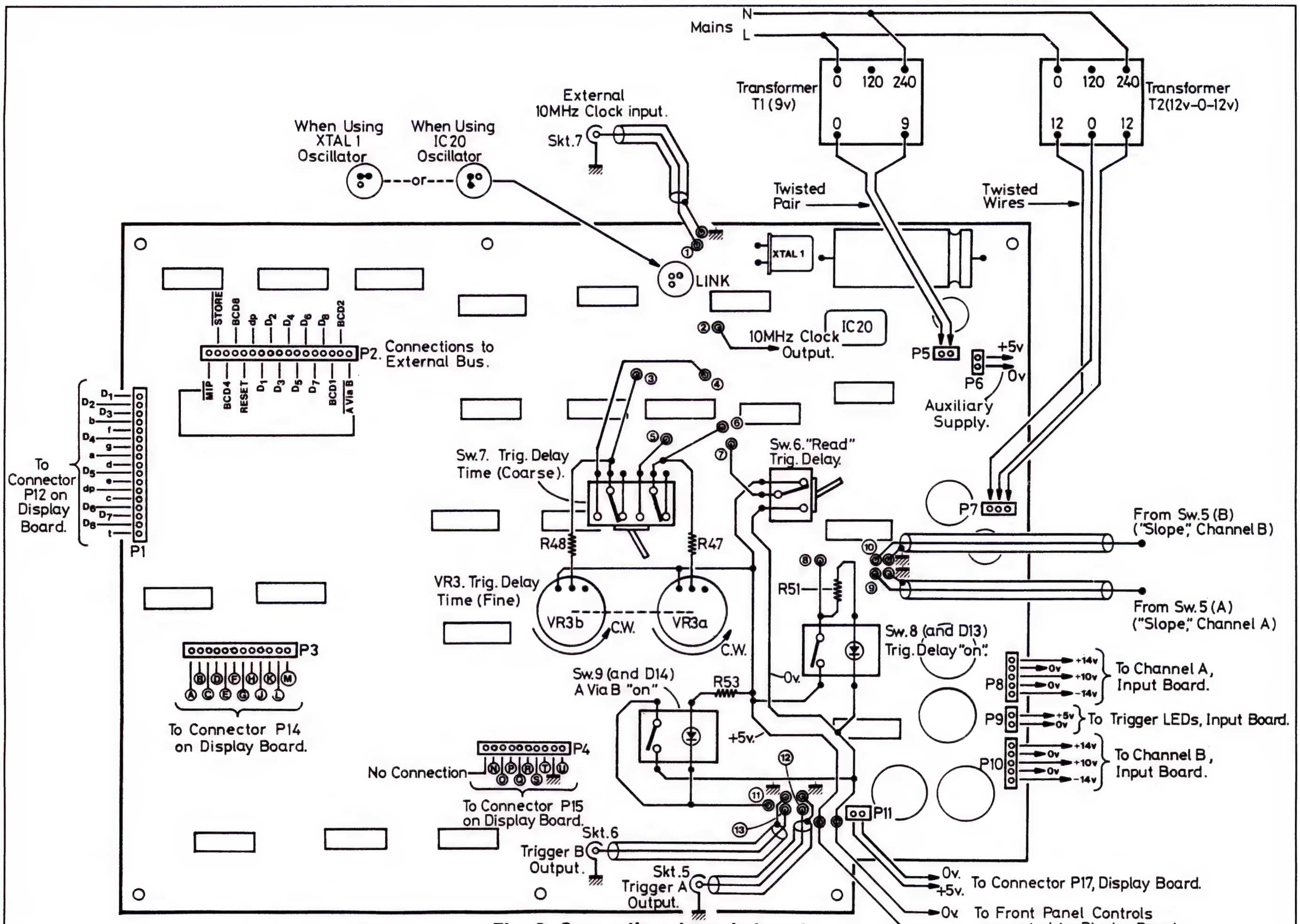

Mains
N
L
Transformer T1 (9v)
0 120 240
0 9
Transformer T2(12v-0-12v)
0 120 240
12 0 12
Twisted Pair
Twisted Wires
External 10MHz Clock input.
Skt.7
When Using XTAL 1 Oscillator
When Using IC20 Oscillator
or
LINK
XTAL 1
IC20
10MHz Clock Output.
P5
P6
+5v
0v
Auxiliary Supply.
P7
STORE
BCD8
dp
D2
D4
D6
D8
BCD2
P2
Connections to External Bus.
MIP
BCD4
RESET
D1
D3
D5
D7
BCD1
A Via B
To Connector P12 on Display Board.
D1
D2
D3
b
f
D4
g
a
d
D5
e
dp
c
D6
D7
D8
t
P1
P3
To Connector P14 on Display Board.
P4
No Connection
To Connector P15 on Display Board.
Sw.7. Trig. Delay Time (Coarse).
Sw.6. "Read" Trig. Delay
R48
R47
VR3. Trig. Delay Time (Fine)
VR3b
VR3a
C.W.
C.W.
R51
Sw.8 (and D13) Trig. Delay "on".
Sw.9 (and D14) A Via B "on"
R53
0v
+5v
From Sw.5 (B) ("Slope", Channel B)
From Sw.5 (A) ("Slope", Channel A)
P8
+14v
+10v
-14v
0v
To Channel A, Input Board.
P9
+5v
0v
To Trigger LEDs, Input Board.
P10
+14v
+10v
-14v
0v
To Channel B, Input Board.
P11
Skt.6
Trigger B Output.
Skt.5
Trigger A Output.
0v
+5v
To Connector P17, Display Board.
0v
+5v
To Front Panel Controls connected to Display Board.
①
②
③
④
⑤
⑥
⑦
⑧
⑨
⑩
⑪
⑫
⑬

Fig. 3. Connections to main board.

With the main board resting on a non-conductive surface, use an oscilloscope to check the voltage at the output of the 7805 regulator. Ensure that the voltage is in the range 4.75V to 5.25V and that there is no ripple present. If there is ripple present check that C82 is soldered into place correctly. If there is no voltage at all, check connections from T1 secondaries through BR1 and F2. If the 7805 is getting very hot, look for a short circuit at the output. If all is in order, the +5V supply should be available at connectors P6, P9 and P11, and also at the veropins directly to the left of P11.

Next, use the scope to check the voltages output at plugs P8 and P10 (the probe ground lead should be connected to zero volts when making all voltage checks). Fig. 3 shows the nominal on-load voltages at P8 and P10. However, as the input board is not yet connected, the no-load voltages should be in the region of +20V, +11V and -20V respectively. There should be negligible ripple voltage on all of these outputs. If there is ripple, check the RC smoothing filter associated with the particular output. If there is no voltage present, trace connections from the transformer through to the outputs.

Calibrating The Input

If the PSU section is in order, the input board can be set up and tested. All connections are shown in Fig. 5. The front panel components are connected to the input board using insulated hook-up wire and flexible co-ax.

For the moment it is only necessary to connect VR1 (fine atten), VR2 (trig level) and S4 (zero trig level) to each input channel. Also, connect R14 to the common terminal of S4. Don't forget to connect the co-ax screens to the relevant terminals as shown in the figure. Before connecting VR1 and VR2, it is best to cut their spindles to the required length. I found the best way to do this is to locate the pots in the front panel, then cut this length off the spindle.

The connections to VR1 and VR2 are shown as though looking at them from the rear such that the direction of clockwise rotation is as shown. It is important to make the connections correctly so that the attenuation caused by VR1 increases with clockwise motion and the trigger level is varied rom negative to positive with clockwise rotation of VR2.

Note, also, that Fig. 5 shows S4 in its zeroed position (on both channels) . To determine which terminals are which, rotate VR2 fully anticlockwise such that the switch 'clicks' and use an ohmmeter to find the closed contacts. One of them is the common terminal which must be connected to R14 whilst the other is the ground connection that will also be connected later to SK3. If the connections to S4 are mistakenly swapped around the trigger level becomes zero over the entire span of VR2 .

The input board is now ready for testing. Whilst conducting the tests, try not to flex the connections any more than necessary. Remember, also, to test and calibrate both channels.

An oscilloscope with 10MHz

bandwidth is required to carry out the calibration. A non-attenuated probe and a probe with x10 attenuation should also be available. Sine and squarewave generators are required, the first being variable from 50Hz to 500kHz with an amplitude range from 500mV to 5V peak to peak (pp). The squarewave generator should range from 10kHz to 10MHz with amplitude from 500mV to 5V.

A high impedance DVM will also be needed for some of the checks. Before starting the tests, temporarily solder a small capacitor in C7 position (both channels). A 10pF ceramic should be adequate to stop IC1 breaking into spurious oscillation.

Supply Rail Checks

Connect the three ribbon cables to the main board and switch the mains power on. Initially check that none of the ICs, transistors or regulators is getting very hot. If any start cooking or should anything go bang, switch off immediately and check for short circuits and wrong connections.

If everything is in order leave the power on for ten minutes and then use the DVM to measure the output voltage of the 78L08A regulator (IC6). The voltage should be in the range +7.6V to +8.4V. Now connect the DVM to the output of IC7 and adjust PR2 such that the negative rail voltage is equal in magnitude to the positive rail voltage measured above. If the adjustable voltage scheme is not being employed, that is, if IC7 is a 79L08A, simply check that the negative rail is in the range -7.6V to -8.4V. The voltage output of the 78L05A should be +4.74 to 5.25V.

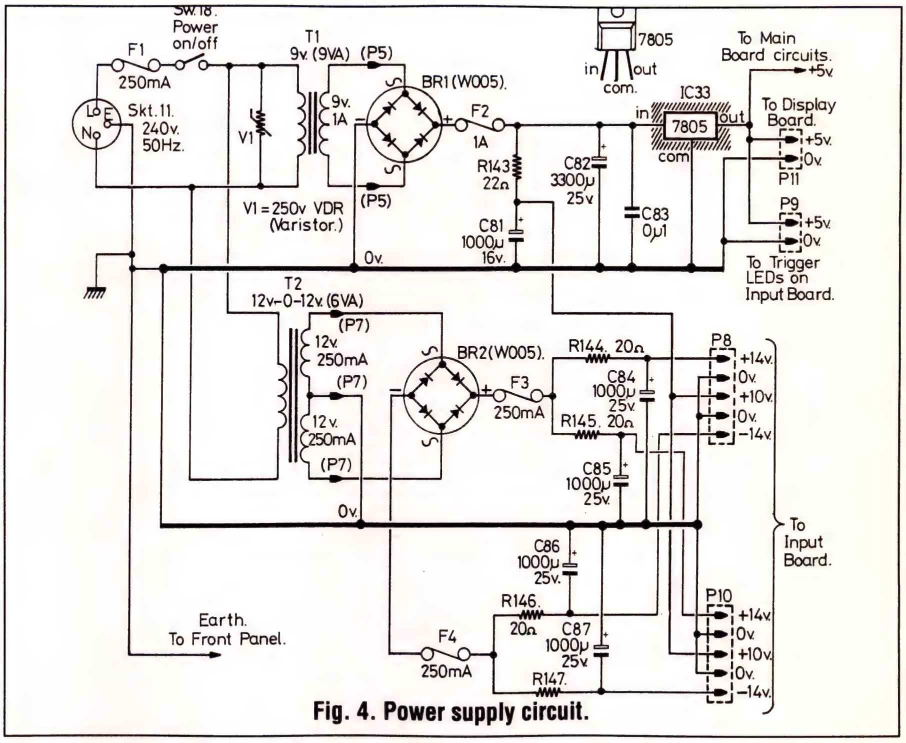


Fig. 4. Power supply circuit.

Next temporarily short the channel input to ground . Then zero S4 (turn VR2 fully anticlockwise till the switch clicks), select all-pass filtering and set attenuation to x1. Leave the power switched on for another 20 minutes or so.

Nulling The Op-amp.

By this time the potentials in and around the op-amp (IC1) will have had time to settle to their quiescent values and the op-amp can be nulled. Monitor the output at pin 11 by connecting the scope or DVM to the high end of R12. If the scope is used here select the most sensitive range and DC couple the input from a non-attenuated probe.

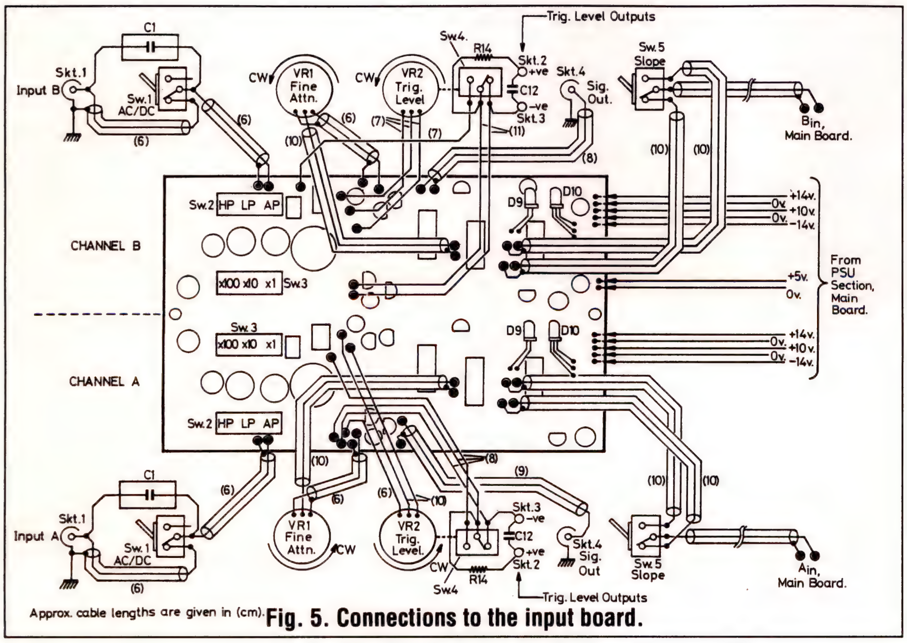


Fig. 5. Connections to the input board.

Now, adjust PR1 to bring the op-amp output to zero. It is essential that S4 is zeroed during this procedure or the trigger offset will also appear at the op-amp output.

Remove the link wire from the input pins such that the input is open circuit. The aim is to find the best combination of C7 and C8 to give optimum op-amp compensation.

The procedure is to couple a 500mV squarewave directly to pin 6 of the op-amp (the junction of R9 and R10). Then at a frequency of 10MHz, observe the op-amp output on the scope and compare it with the input signal.

The aim is to choose the capacitors such that the output is a replica of the input but with ten times the amplitude. It is important that the input signal be as rectangular as possible . It is also essential to use x10 attenuated probes when comparing the signals or else the input capacitance of the scope will cause distortion. Keep the leads from the squarewave generator as short as possible to reduce ringing and connect the ground leads as close as possible to IC1.

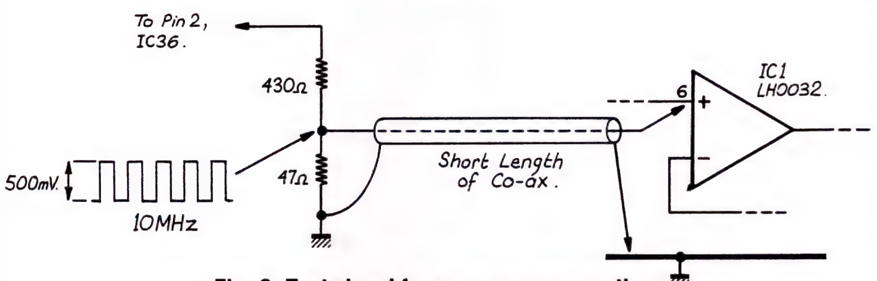


Fig. 6. Test signal for op-amp compensation.

It is possible to use the clock of the Chronos' timebase for the squarewave. This is a 5V 10MHz signal available at the pin 2 of IC36 on the main board. The signal must first be attenuated to 500mV before feeding it to the op-amp as shown in Fig. 6. The attenuated signal should be fed to the op-amp using a very short length of co-ax as shown. Remove the resistive divider when the test is completed.

Further Compensation.

The next thing to select is the optimum compensation for the network by trimming VC3. With S2 and S3 still set to AP and x1, DC couple a 500mV 10kHz square wave to the channel input. Once again, compare the input signal with the op-amp output using unattenuated leads.

Now, carefully adjust VC3 such that the op-amp output is the same as the input. When all the beehive trimmer caps have been adjusted, don't be tempted to apply any kind of sealing compound as this can change the capacitance.

Select x10 attenuation (S3 centre position) and DC couple a 5V, 10kHz squarewave to the channel input – S2 is still set to AP. Use non-attenuated probes to compare this signal with that as the op-amp output. Adjust VC2 to make the signals identical. The same should be done with the x100 attenuation by adjusting VC1.

On The Trigger

Use a short wire link to ground the channel input , select AP filter and x1 attenuation and use a DVM or scope with non-attenuated probe to monitor the output of IC1. With S4 zeroed, the output should be zero. Turn VR2 slightly clockwise so that the switch just clicks and the output voltage should jump to a value in the region of +5V to +6V. Gradually turning VR2 clockwise will cause this voltage to drop, go through zero and end up[at -5 to -6V.

For different values of trigger level offset at IC1 output, check that the voltage at the signal monitor output (junction of R20-R21) is the same. Remove the ground link from the input and repeat for the other channel.

Filter Performance

Select zero trigger level and x1 attenuation. AC couple a 500mV peak to peak sinewave to the channel input and select a low pass filter. Keeping the input amplitude constant, vary the frequency in half decade steps from 1kHz up to 500kHz, the amplitude should have fallen to around 500mV peak to peak (PP).

Now select high pass filtering and with the same 500mV input, vary the frequency from 100kHz down to 50Hz. At 10kHz and above, the amplitude at the output of IC1 should be around 4.5V pp. At 1kHz the signal should be down to 3.2V and at 100Hz down to 450mV.

With the trigger level still zero and attenuation still at x1, select all pass filtering and AC couple a 500mV pp sinewave to the channel input. For decade frequency steps from 10Hz to 1MHz or greater check that the signal output from the buffer (junction of R20 and R21) is an undistorted sinewave with 5Vpp amplitude.

If the waveform is distorted, check the signal paths from IC1 and the transistors. If only half the wave is distorted suspect TR2 and TR3 otherwise try TR1 and TR4.

With zero trigger level, x1 attenuation and all pass filtering, ensure that VR1 is set to minimum attenuation (fully anti-clockwise) and set frequency of 500mV input sinewave to about 200Hz. Observe the output of IC1 on a scope this should be a 5Vpp sinewave swinging symmetrically around 0V. The trigger LED should be flashing and the ODR detector LED off.

Now rotate VR2 slightly clockwise so that the switch just clicks. The signal at IC1's output is forced fully positive with the peaks being clipped at around +7V. Because the signal is above the trigger window, the trigger LED should be continuously on. Also, the signal clipping resulting from op-amp saturation is caused by the large trigger level pushing the signal outside the dynamic range.

Slowly turn VR2 clockwise and the clipping of the positive peaks should grow less and eventually disappear. At this point the ODR LED goes out.

Continue turning VR2 clockwise. As the negative peaks pass through zero, the trigger LED should begin to flash. Eventually, as the signal is taken more negative, the positive peaks will fall below zero such that triggering ceases. As the signal is taken fully negative it will be clipped at around -7V.

Set VR2 to its centre position and observe the output from IC5b (pin 4 IC5). This should be a squarewave in phase with the sinewave. Now rotate VR2 clockwise, the duty cycle of the square wave should reduce correspondingly.

Final Test

The last test is with the filters set to AP with x1 attenuation selected. Couple a 200Hz 500mV sinewave to the channel input and set the trigger level to zero. Using a non-attenuated probe, observe the signal on pin 4 of IC4. It should be around 3.5Vpp. Slowly rotate VR1 clockwise so that the amplitude decreases. Eventually there will come a point where the signal is too small to cross the Schmitt trigger thresholds and the trigger LED will stop flashing. The positive and negative peaks of the signal at this point should correspond to the upper and lower threshold voltages respectively – ±70mV give or take a few mV.

If the values are different by more than 30mV then check the level shifting network around R27 to R31 and D5 and D6.

After all of this, check the connections to the board to see that they are still firm after all that flexing around. ■

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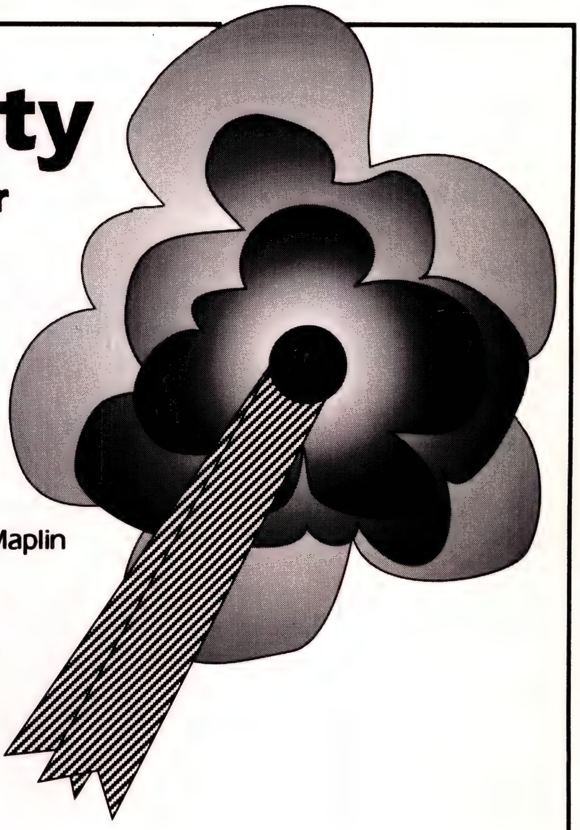

This month's top ten readers:

P Jones of London NW6 has £150 of the money spent with Cricklewood Electronics refunded.

A Morris of Birmingham who bought £150 worth of goods from Panrix Electronics.

J Singh of Ealing receives £112.95 for buying goods from Tandy.

K Peggs of Tring has the £68.22 he spent with Greenweld refunded.

AR Tizzard-Largs of Ayrshire gets back the £67.40 he spent with Maplin Electronics.

RH Morgan of Ellesmere Port traded with Maplin and has £33.70 refunded.

K Peters of Brighton secures his £29.07 for purchasing goods from Suma Designs.

J Muir of Glasgow claims his £19.48 which he spent with Maplin.

CR Rounce from Doncaster is reimbursed £13.33 for trading with Maplin.

R Aldridge of Ramsgate has £4.27 repaid for his purchase from Tandy.

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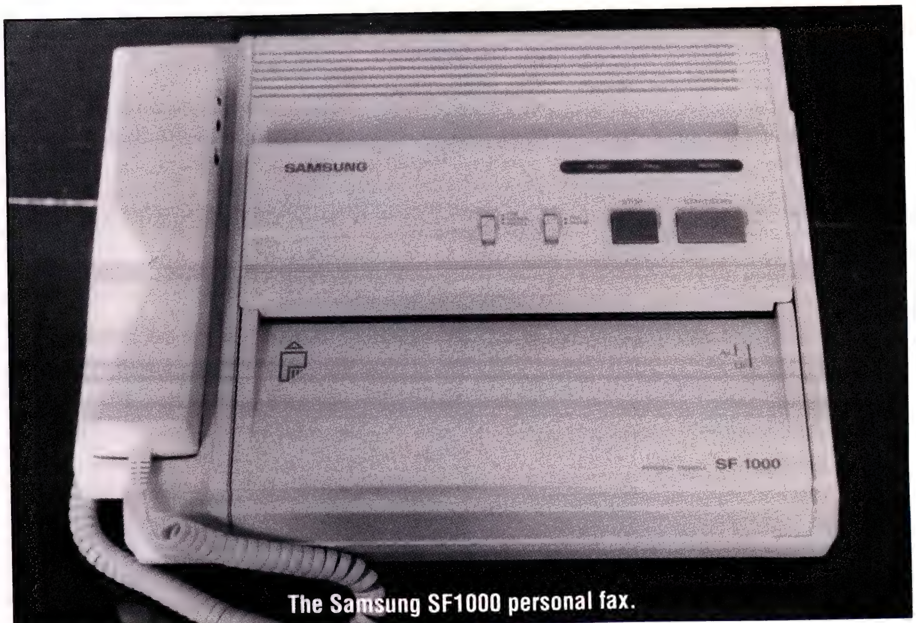
The Facsimile Machine What Are The Fax?

Kevin Jones looks at the technology that enables pictures to be sent down the phone. Now that the prices are falling, are they for everyone?

The facsimile machine or fax looks as though it will soon replace the portable phone as "the latest gadget". Prices are now falling to the point where machines can be purchased not only by businesses as standard office equipment but also by individuals for home use.

The advantage of fax over telephone is not just the ability to send pictures to your friends. It also means that messages can be left when they are out and letters can be sent in the evenings at cheap rates to be read first thing next morning. In addition, an A4 page of text can be sent in under 30sec or so – try reading out a page of text at this speed. Yet another plus is that the machine can be used as a photocopier. The only real drawback at the moment is that not everyone has one.

Until recently the problem of having a fax at home was the requirement for two telephone lines. Fortunately, the use of a fax/telephone/answerphone or a switch box means that now, systems can be run on a single line. For anyone thinking of purchasing a fax and who doesn't already have an answerphone, the combined option is the best. A machine which incorporates all of the latest telecommunications gear in one box such as the Amstrad FX9600AT, although not cheap, provides a neat solution.


The Samsung SF1000 personal fax.

Voice Or Tone

For anyone who already owns an answerphone, the switchbox is the way to go. This gadget that connects directly to the telephone line and provides two outputs, one for the telephone/answerphone and one for the fax. When a call is received, the box answers the phone and sends out its own ringing tone while it attempts to work out whether the call is from a person or a fax. When they dial up a number, fax machines send out tones for the answering machine to lock onto. The switch box, on hearing these flicks the call through to the fax machine which answers the call and receives the fax. If no tones are heard then the call is switched through to the telephone or answerphone. Most of the time this works very well, but, unfortunately, some foreign telephone voice calls seem to put tones on the line which the switch box mistakes for fax tones. In this case, the handset on the fax (if it has one) can be used to receive the voice call or the switch box can be manually made to operate with the phone. Of course, this is of no use to an answerphone.

The opposite problem also occurs occasionally and a series of bleeps can be heard on picking up the phone or on the answerphone. The reason for the switch box misunderstanding the signals is not clear though it doesn't happen very often.

Having both fax and answerphone in one box is not the

Specifications

Samsung SF1000 Personal Fax
Compatibility: CCITT group 2 and 3
Speed: 9600/7200/4800/2400 bps
Resolution 3.85 lines per mm (normal) or 7.7 lines per mm (fine)
Scanning method: CCD image sensor
Grey scale: 16 levels
Printer output: thermal Input
Document size 216mm wide
Paper roll length: 30m
Power: 220-240VAC
Dimensions 330x254x107 (WDH)
Weight 8.8lbs

Box. Inside Fax

All fax machines use roughly the same hardware and transmission/reception methods. The CCITT standards for sending fax data down a telephone line are G2 and G3. The difference between the two is one of speed and reliability. G3 runs faster than G2 but G2 is more reliable. For noisy telephone lines, G2 is the route to take, however, complaining to BT about line noise is also a possibility. Most modern machines support both standards and have modems that operate from 9600 bits per second (bps) downwards - a fallback technique uses the lower speeds if data is being lost diring transmission.

When an image is being sent, it is slowly fed through the machine and scanned by a long strip CCD sensor. In normal or fine modes, the data is in the form of ons and offs defining where the black or dark areas of the image are. This data is then coded up, usually using a variable length code where the more frequent numbers use shorter word lengths and hence transmit more quickly. A consequence of this is that more complex areas of the image tend to be sent more slowly - this is noticeable when a fax machine gets past the white space and onto the text.

As well as transmitting and receiving images as normal or fine resolution, a photographic option converts the brightness of a pixel into a value from 0 to 15, known as a grey scale. This allows much better resolution of photographic images at the expense of a decrease in speed.

At the receiving end, the fax will have set itself up to the correct speed and resolution when first contacted. The ensuing information will then be decoded and printed out onto heat sensitive paper. This normally comes on a single roll and on some machines is cut to size at the end of each transmitted sheet and on others simply left for the user to tear off.

The Amstrad FX9600AT personal fax and answering machine.

Specifications

Amstrad FX9600AT Personal Fax and answering machine

Fax

Compatibility: CCITT group 3
Speed: 9600/7200/4800/2400bps
Resolution: 3.85 lines per mm (normal) and 7.7 lines per mm (fine)
Scanning method: CCD image sensor
Grey scale: 16 levels with two styles
Printer output: thermal
Document size: 216mm
Paper roll length: 30m
Automatic paper cutter
10 page document feeder
Power: 220-240VAC
Dimensions: 380x340x128 (WDH)
Weight: 6.75kg

Answering machine

Outgoing message: 16s max
Incoming messages: stored on C30 micro-cassette
Automatic Fax/phone switching

perfect solution either. On receiving a call, the machine plays its voice message. If, when this has finished, some tones are heard, the system enters fax mode. Otherwise, a voice message is taken. Unfortunately, when sending a fax, hearing a voice at the other end of the line instead of the expected bleeps usually means a wrong number. In the case of an "intelligent" fax/answerphone, it's just a matter of waiting out the voice message before sending the fax -- as long as you know.

Simple Or Sophisticated

There are a wide selection of fax machines available. The bottom end of the range is represented by the Samsung SF1000 personal fax. This operates with the normal G3 or G2 standards and is able to send and receive, standard, fine or photographic (grey scale) images. It has its own telephone handset with 10 memories for regularly used numbers plus a manual redial. On the minus side, it is only able to take one sheet of paper at a time though multiple sheets can be transmitted if they are fed in by hand. There is also no paper cutter so the received sheets must be torn of at the end of a message.

The other big problem is encountered when setting it up. To save money there is no message display screen. This means that optiona such as identification codes printed on the message, whether to default to G2, how many rings should occur before answering and so on, must all be set up by pressing the start and stop buttons in a defined sequence. The results can then be checked by printing them out.

At the other end of the market is the Amstrad FX9600AT which incorporates an answering machine, auto redial, 20 memories, built in parallel interface allowing connection to a computer which can then send faxes and use the thermal printer for output. This is a more complex machine with a large number of facilities. The provision of a coimputer interface will appeal to users with PCs since text can be sent directly from a wordprocessed document directly to someone elses fax, saving both time and paper.

The fax machine appears to have reached its peak technologically. All that remains is for the price to fall a little more and most people will wonder how they managed without it. ■

Counting The Pulses

Pulsar is Number 1 Systems' latest piece of computer aided design software aimed at making logic circuit design and testing easier. Kenn Garroch checks it over.

In the bad old days, designing and building digital electronic circuits was a complicated affair that required an in depth knowledge of techniques such as state machines and transition tables.

After designing a circuit and "proving" that it works on paper, the only way to make sure it works is to solder some silicon. An alternative, just released for the IBM PC, is Pulsar. This digital logic simulator allows a circuit to be checked out to the stage where it should work in reality. Digital circuits can be put through their paces with all inputs and outputs being available for scrutiny. A knowledge of digital systems is still necessary although Pulsar could be used in conjunction with some textbooks to learn all about the subject.

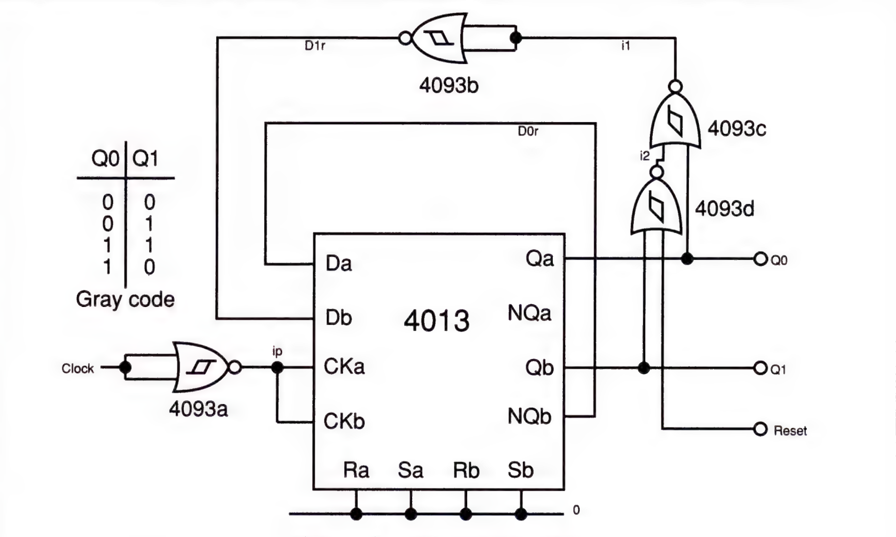


Fig. 1. A grey code generator.

Running Under A GUI

Pulsar comes on both 3.5in and 5.25in disks. Installation is straightforward and from inserting the floppy to getting the thing running takes only five minutes or so. A PCXT/AT with at least 512kb of RAM, a hard disk and either an EGA or VGA graphics card is the minimum system needed to run Pulsar. A mouse is also a pretty handy accessory to have available although it is possible to use the software via the cursor keys.

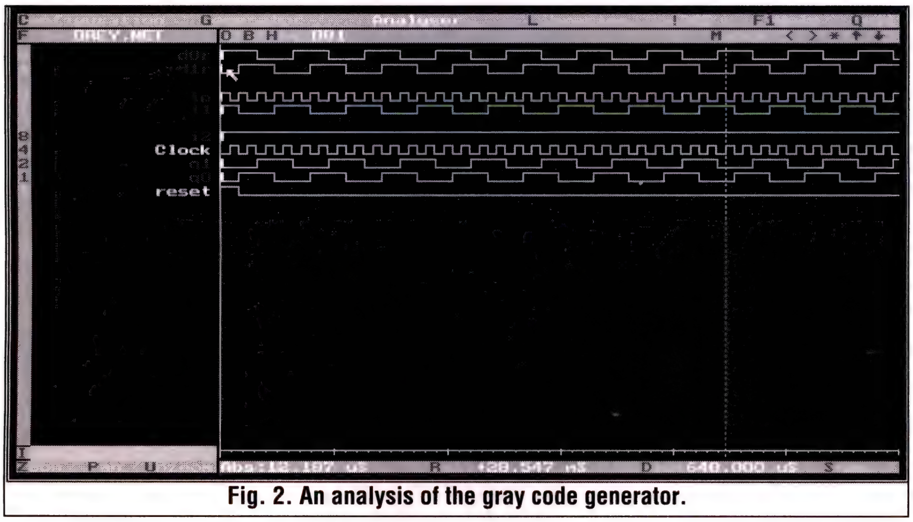
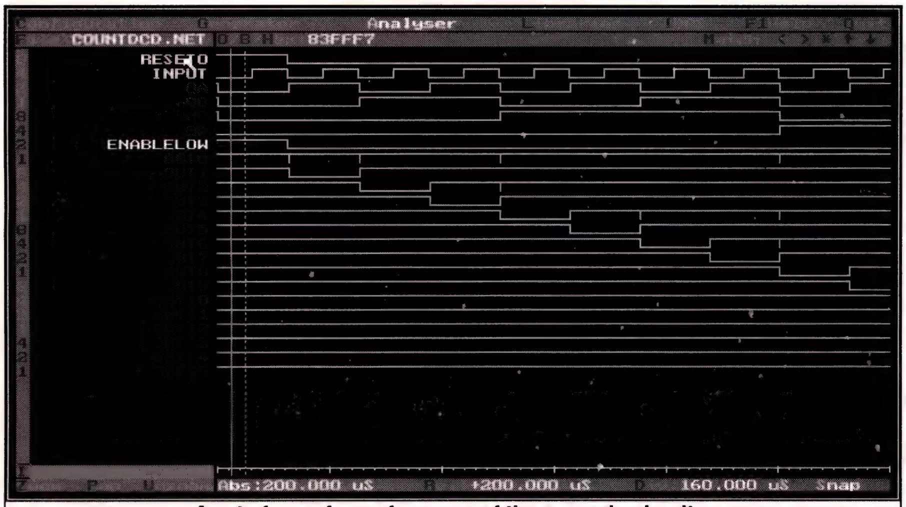


Fig. 2. An analysis of the gray code generator.

The whole package operates through a GUI (Graphical User Interface) complete with pull down menus and button clicking. In general these menus are easy to navigate and each has a help section at the bottom. Unfortunately, the help comments usually run to repeating what is already obvious and a more in-depth help system would have been a good idea. The manual is of some use in this area but it doesn't really have a reference section so trolling through it from end to end is usually the only way to find out about something.

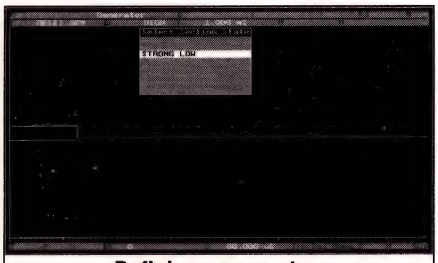
Gray Code Simulation

Circuits are set up in Pulsar by taking predefined components or modules and assigning their inputs and outputs to each other. To do this properly it is necessary to draw up a design with a pencil and paper



A set of waveforms from one of the example circuits.

before even going near the editor – a fully graphical schematic editor would have made life a great deal easier. Users of Easy PC will find that they can output netlists directly into the system making the operation a lot easier. Others will have to suffer and do it by hand.



Defining a generator.

The program has four main sections, the analyser, circuit create/modify, a generator definer and the component/module library manager.

As an example, to set up the gray code circuit shown in Fig. 1, each of the nodes of the circuit is given a name and each component is given the corresponding node names at its connections. A component not shown in the diagram is the PSU or power supply. This provides two outputs, one is assigned to "1" and one to "0". These can then be used in the rest of the circuit to tie inputs high and low as necessary.

Having completed the definition, the next step is to load up the circuit into the analyser. However, before starting any analysis a couple of external generator inputs need to be defined. The "clock" input is taken straight from a standard 1kHz signal provided with the system and the "reset" input defined especially for the the test.

The generator definer allows almost any input signal to be set up by specifying the high, low and time for each step. The reset signal is simply a short high level followed by a 10 second low, long enough to prove the circuit.

Building Black Boxes

Back in the analyser, the generators are attached and the simulation run producing the outputs shown in Fig. 2. Outputs Q1 and Q0 give the gray code as shown in the truth table.

The main requirement for designing a circuit is to put it down on paper and name the nodes and components. The libraries cover virtually all the standard CMOS 4000 range, the 74LS range and a set of system components. Simply entering the name gets the component from the library complete with connection definitions. A drawback with the system is that there is no facility to browse the libraries to see what is available – in graphical form preferably.

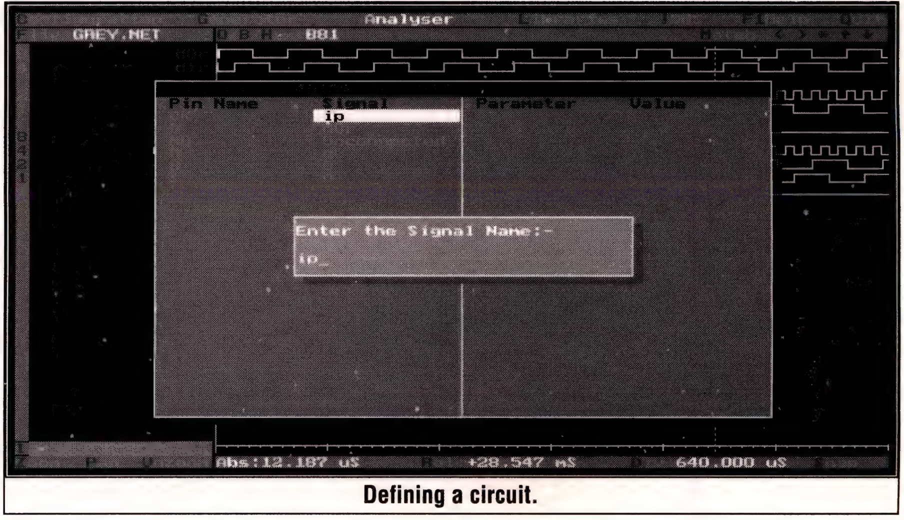
Once a circuit is proven it can be set up as a module which is, in effect, a black box with defined inputs and outputs. Modules are held in libraries and can be used in future circuits. This idea allows sections of a circuit to be designed and checked out and then connected together to form more complex systems.

When the simulation has been run all of the relevant waveforms are displayed on the screen. These can be shifted up and down the screen and grouped to make them easier to read. The controls allow zooming in on the display and panning.

The Package

The manual supplied with the software could be better. It takes the user on a "grand tour" of the software. This is quite long as there is an awful lot to see. Unfortunately, there is very little in the way of reference material. The index is reasonable and the appendices show all of the components held in the libraries.

Pulsar is a pretty sophisticated piece of software. It can cope with complex circuits and although it looks complicated at first sight, it is not hard to get to know and use. Anyone who wants to do a lot of digital design or who is interested in learning a lot about digital circuits might be interested. However, at £195 it may be priced beyond anyone who is not going to get a great deal of use from it. ■



Enter the Signal Name:-
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Defining a circuit.

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OMP/MF200 Mos-Fet Output power 200 watts R.M.S. into 4 ohms, Frequency Response 1Hz – 100KHz −3dB, Damping Factor >300, Slew Rate 50V uS, T.H.D. Typical 0.001%, Input Sensitivity 500mV, S.N.R. −130dB. Size 300 × 155 × 100mm.
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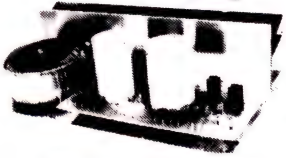

OMP/MF300 Mos-Fet Output power 300 watts R.M.S. into 4 ohms, Frequency Response 1Hz – 100KHz −3dB, Damping Factor >300, Slew Rate 60V uS, T.H.D. Typical 0.0008%, Input Sensitivity 500mV, S.N.R. −130dB. Size 330 × 175 × 100mm.
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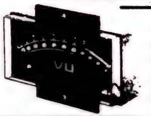

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RES. FREQ. 45Hz FREQ. RESP. TO 7KHz SENS. 98dB .... **PRICE £36.66 + £3.50 P&P.**
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RES. FREQ. 40Hz FREQ. RESP. TO 4KHz SENS. 99dB .... **PRICE £80.53 + £4.50 P&P.**
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RES. FREQ. 40Hz FREQ. RESP. TO 7KHz SENS. 97dB .... **PRICE £8.90 + £2.00 P&P.**
10" 50 WATT EB10-50 DUAL IMPEDENCE, TAPPED 4 8 OHM BASS, HI-FI, IN-CAR.
RES. FREQ. 40HZ FREQ. RESP. TO 5KHz SENS. 99dB .... **PRICE £12.00 + £2.50 P&P.**
10" 100 WATT EB10-100 BASS, HI-FI, STUDIO.
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RES. FREQ. 28Hz FREQ. RESP. TO 3KHz SENS. 92dB .... **PRICE £21.00 + £3.00 P&P.**
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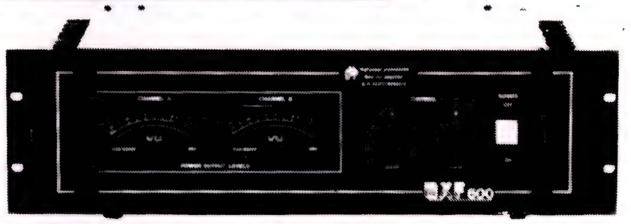

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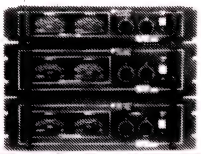

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2.5K WATT £24.99 + 60p P&P

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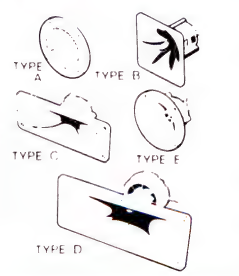

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Measuring Up Digital Multi-Meters

The number of DMMs available is on the increase. They now offer larger displays, more functions and lower prices than ever before. Jason Sumner examines a selection of seven.

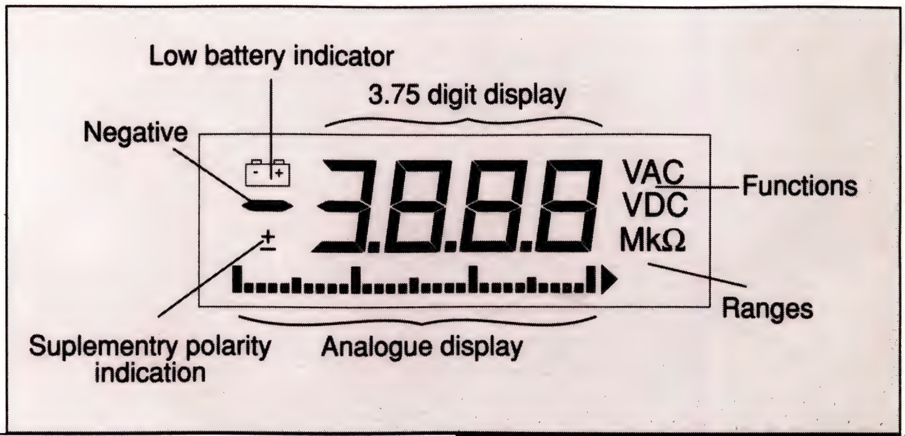
It seems that the days of the analogue multi-meter are just about over. The DMM (Digital Multi-Meter) has now come to the fore offering more facilities at a lower cost and in a more robust and compact case.

The three main functions supported by DMMs are Amps, Volts and Ohms (Ω) measuring current, voltage and resistance. Other options becoming common are diode and continuity test, with the latter usually providing eyes-free operation by means of a sounder.

In general, all the meter displays are the same (see right). The main section is the 3 (plus a fraction) digits used for the main readout. The fraction is usually half a digit in the form of a 1 giving a maximum count of 1999. Some meters offer three quarters of a digit in the form of a 3 allowing counts up to 3999. All types normally allow two to three decimal places of accuracy if the correct range is selected.

Some instruments offer a semi-analogue display in the form of a bar graph across the bottom of the readout. Other indications may be the units, the current function, the polarity of the signal and whether the battery is due to be replaced.

Since many DMMs offer pretty much the same basic facilities, any additional options should be taken into account when selecting between different makes and models.



This meter is unusual for a hand held DMM in that its on/off switch is separate from the range selection dial. The only drawback with this is that it is possible to turn the meter on while it is on an unsuitable scale – for example, when connected up to measure volts and switching on with the ohms range selected.

Other features include a memory which remembers the last two digits of the current reading. These are then subtracted from the next reading to allow measeument of voltage or current deviation. The hold button keeps the display static until released and DC/AC/Ω/Lo switch allows measurement of AC or DC voltage and current or low and high resistance.

The only real problem with the DMM735 is that due to the colouring of the case (shades of brown) it could easily get lost when put down.

Specifications

735 DMM
3.5 digits, 1999 count
Auto/manual range selection
Overrange indication
Sampling 2Hz
Low battery indicator
Battery type 9V
Size 148x60x23mm (LWH)
Wight 180g
Comes with battery, test leads, crocadile clips and manual
Price £49.95 (£58.69 in VAT)

0 – 1000VDC	Auto
0 – 750VAC	Auto
0 – 10ADC	Auto
0 – 10AAC	Auto
0 – 2MΩ	Auto

Global Specialities,Rackery Lane,Llay
Wrexham,Clwyd,LL12 0PB

The first striking thing about the TM357 is that the on/off switch is very small. It is also seperate from the function selector dial and so sufferes from the same problem as the DMM 735. The display is rather basic and only shows the reading and low battery warning. All ranging must be performed by the user and there is no indication of the scale of the display – it is difficult to tell between kΩ or and Ω for example. The overrange indication is a static 1 on the display; making it flash would have made operation easier.

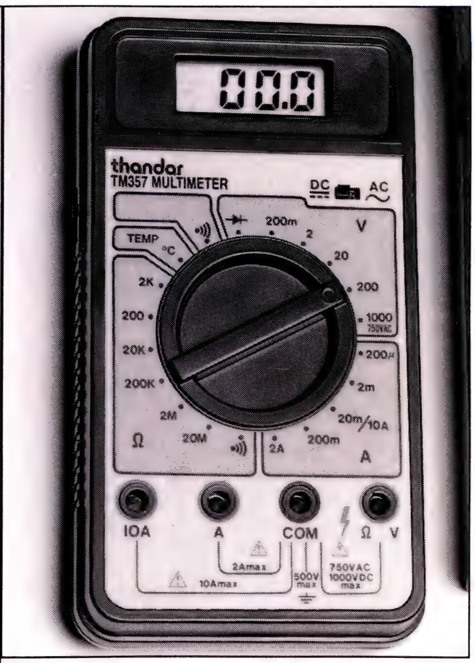
Leaving the meter on just seems to drain the battery as there is no auto-shut off. On the plus side, the instrument is relatively cheap and has a built in prop-up stand on the

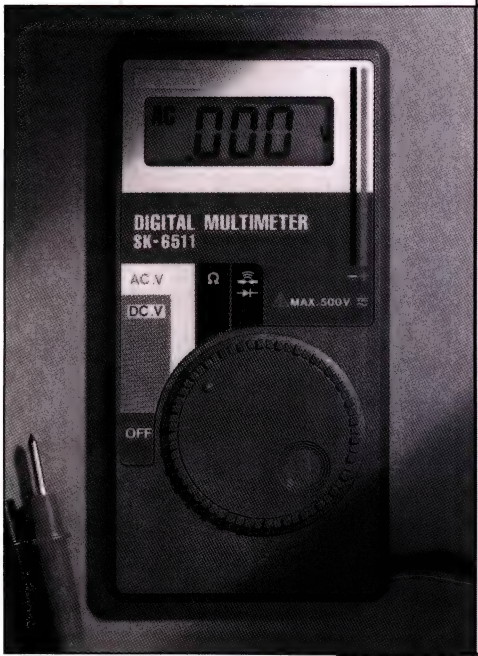
Specifications

TM357
Display 3.5 digits 1999 count
Manual range selection
Overrange indication
Sampling rate 2.5Hz
Low battery indicator
Battery type PP3 9V
Size 150x80x30mm (LWH)
Weight 240g
Continuity and diode check
Comes with test leads and manual
Price £39 (£45.83 inc VAT)

0 – 1000VDC	5 ranges
0 – 750VAC	5 ranges
0 – 10ADC	6 ranges
0 – 10AAC	6 ranges
0 – 20MΩ	6 ranges

Thurlby Thandar, 2 Glebe Road,
Huntingdon, Cambs, PE18 7DX





Specifications

SK6511
Display 3.5 digits, 1999 count
Auto range selection
Overrange indication
Sampling rate 2Hz
Low battery indicator
Battery type two 1.5V LR-44
Size 108x54x8mm (LWH)
Weight 60g
Features continuity and diode check
Comes with batteries, manual, test leads and carry case
Price £19.95 (23.44 inc VAT)

0 – 500VAC	Auto
0 – 500VAC	Auto
0 – 20MΩ	Auto

Global Specialitie
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Wrexham,Clwyd, LL12 0PB

Obviously designed to be carried around in the pocket this meter is about as simple as they come. One control dial selects the function with any ranging taken care of automatically.

No current measurement is supported and the probes are quite small, especially for those of us with banana fingers. The batteries are similar to those used in cameras and getting them in and out requires a very small screwdriver and some fiddling. However, they have an operational life of approximately 70 hours continuous use so they won't need to be changed too often. On the other hand, since there isn't an automatic switch off the batteries will eventually go flat if the meter is

Offering a large display (75x30mm) the TM3487B also has a few functions not normally found on a DMM. The most obvious is that it is able to measure frequencies. It also has a horizontal bar graph display which gives a semi-analogue average display of the reading. The relative option allows signals to be compared and the max/min the instantaneous maximum and minimum peak values. All ranging is done automatically with the units shown on the display.

On the minus side, when the display is viewed at shallow angles, various elements of the display appear to be activate when they are off and there is no auto-shut down to save the battery. The manual is not particularly informative and the prop-up stand seemed particularly flimsy.

Specifications

Thurlby Thandar 3487B
Display 3.75 digits 1999 count
Auto/manual range selection
Overrange indication
Sampling rate 20Hz
Low battery indicator
Battery type 9V PP3
Size 162x80x30mm (LWH)
Weight 250g
Features continuity sounder, diode check and frequency counter
Comes with test leads, battery and crocodile clips
Price £89 (104.58 inc VAT)

0 – 1000VDC	Auto
0 – 750VAC	Auto
0 – 10ADC	Auto
0 – 10AAC	Auto
0 – 40MΩ	Auto
45 – 40kHz	Auto

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Schlumberger-Enertec 5218 Three Trace 200MHz Delay Sweep	£550
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Philips PM3217 Dual Trace 50MHz Delay Sweep	£400
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THIS IS JUST A SAMPLE – MANY OTHERS AVAILABLE

Racal/Dana Wideband Level Meter 5002	£1000
Racal/Dana Synthesized Sig Gen 10KHz–104MHz	£750
Racal/Dana (AIM) LCR Databridge 9341	£350
Wayne Kerr LCR Meter 4210	£600
Wayne Kerr Automatic Component Bridge B605	£450
Wayne Kerr Universal RF Bridge B602	£150
Wayne Kerr Component Tester B424	£125
Farnell Synthesized Oscillator DSG1 0.0001Hz – 99.99KHz	£275
Farnell Automatic Mod Meter AMM	£250
Bradley Oscilloscope Calibrator 192 with Cal Cert	£800
Marconi TF2008 AM/FM 10KHz–310MHz Sig Gen	£400
Marconi TF2015 AM/FM 10–520MHz Sig Gen with TF2171	£400
Marconi TF2015 without Synchroniser TF2171	£250
Marconi TF2016 AM/FM 10KHz–120MHz Sig Gen with TF2173	£350
Marconi TF2016 without Synchroniser TF2173	£175

Bruel & Kjaer Sound Level Meter
2206– 1/2" mic.
with carrying case £160 each
other B&K equipment available

Marconi TF2358/2357 Level Osc/Meter 20MHz	the pair £350
HP 8620C Sweeper Main Frame 10–1300MHz	£800
HP Spectrum Analyser System with 8554 & IF Plug-in, 10KHz–180MHz	£3250
HP Spectrum Analyser System with 8554 & IF Plug-in, 500KHz–1250MHz	£1750
HP Spectrum Analyser System with 8553 & IF Plug-in, 1KHz–10MHz	£1400
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Philips PM6622 Universal Timer/Counter. 80MHz 9 Digit	£130
Feedback SFG606 Sweep Fun Gen. Sine/Sq/Tri 0.01Hz–1MHz	£140
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Leader LMV186a Two Ch MV Meter 5Hz–500KHz, 1mV–300V	£100
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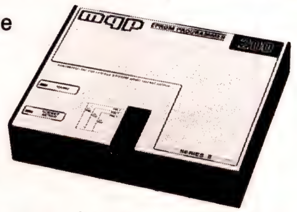

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Possibly the only drawback with this meter is the fact that it doesn't support current measurement. The casing has a very solid feel and looks as though it could take quite a lot of hammer. The display supports analogue as well as the standard 3.75 digits.

The touch hold facility allows eyes-free measuements to be taken. When in this mode the probes can be placed on the circuit and when the instrument beeps, the measurement is held until another is made. As with other devices there is no auto-shut off though battery life is rated at 1600 hours.

As a basic DMM the 70 has a professional air and is supported worldwide by Philips in Europe and Fluke in the States.

Specifications

Philips/Fluke 70 series II
Display 3.75 digits 3200 count
Auto/manual range selection
Overrange indication
Sampling rate unknown
Low battery indicator
Battery type 9V NEDA
Size 166x28x75
Weight 340g
Comes with battery, test leads and manual
Price £59 (£69.33 inc VAT)

0 – 1000VDC	Auto
0 – 300mVDC	Auto
0 – 750VAC	Auto
0 – 32MΩ	Auto

Available from:
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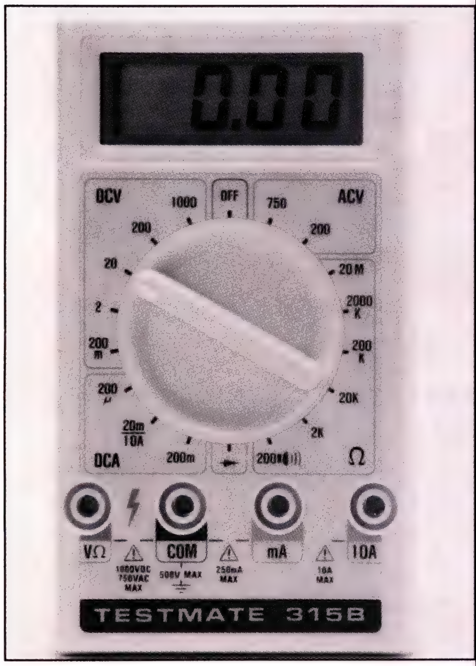
Harlow, Essex



Specifications

Cirkit TM 5315B
Display 3.5 digits 1999 count
Manual range selection
Overrange indication
Sampling rate 3Hz
Low battery indicator
Battery type 9V NEDA
Size 128x72x33mm (LWH)
Weight 200g
Comes with test leads and manual
Price £19.99 inc VAT

0 – 1000VDC	5 ranges
0 – 750VAC	2 ranges
0 – 10ADC/AC	4 ranges
0 – 20MΩ	6 ranges

Available from:
Cirkit Distribution Ltd, Park Lane,
Broxbourne, Herts, EN10 7NQ
Tel 0992 444111

Being brightly coloured, small and solid feeling, the TM5135B gives the impression of being good value. It only provides the basic functions for amps, volts and ohms plus a diode check but, for the price, these are all that can be expected.

On the back of the case is a fold out stand which props the meter up a forty five degrees.

On the front, the power switch is incorporated into the function selector dial – it isn't easy to switch the meter onto a low value range while measuring a high value since the ranges either side of off are 1000VDC or 750VAC.

The display is quite small but large enough to be readable under most conditions.

The TM175 from Cirkit is a pretty high spec meter for the price. The only problems are the separate power switch, the lack of autoranging and the small display. Apart from this, it offers a number of functions not found on the other meters in this review, capacitor and transistor measurement. There are sockets for both types of component built into the bright yellow case.

A built in stand provides either a prop or a hanger for ease of operation. An interesting display option is the up/down indication for logic testing. Whether this makes testing eaiser than reading the voltages +5V and 0V, it is difficult to say, it depends on what you are used to. ■

Specifications

Cirkit TM175
Display 3.5 digits 1999 count
Manual range selection
Overrange indication
Sampling rate 3Hz
Low battery indicator
Battery type 9V NEDA
Size 160x84x38 (LWH)
Weight 250g
Comes with test leads and manual
Price £57.96 inc VAT

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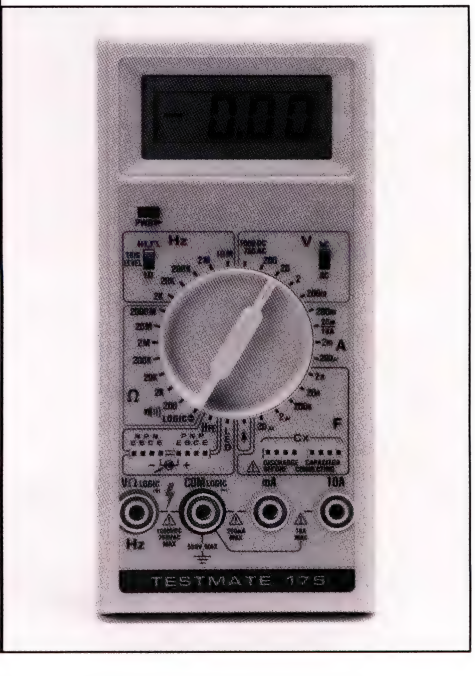
0 – 750VAC	5 ranges
0 – 10ADC	4 ranges
0 – 10AAC	4 ranges
0 – 2000MΩ	7 ranges
0 – 15MHz	5 ranges
0 – 20µF	5 ranges

Transistor and diodes test built in



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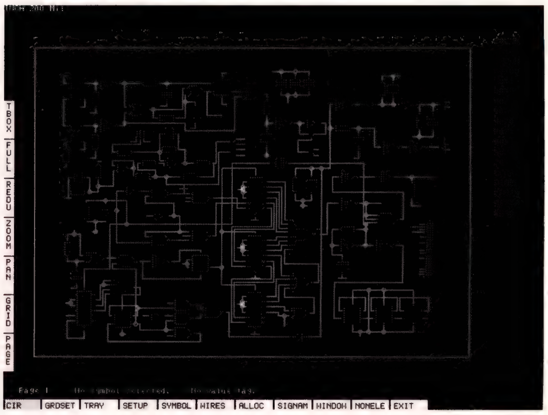
  b Single Metal Diode
  c Semiconductor Micro Device

2 What does an autorouter do?
  a draws the tracks on the board
  b places the components automatically
  c does all the soldering

3 What are the track on a PCB made from?
  a Aluminium
  b Copper
  c Iron



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Ranger 1 takes you from schematic to PCB.

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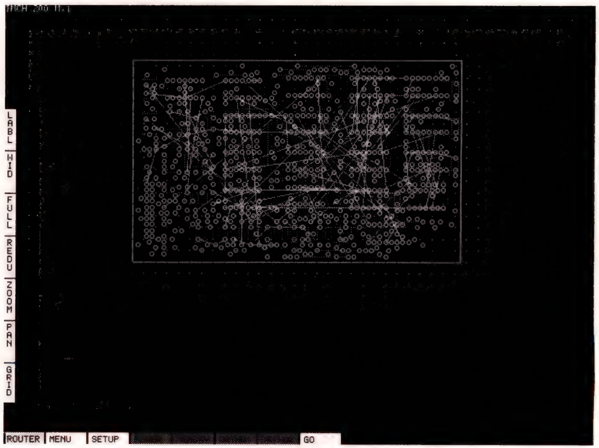

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Techniques

Andrew Armstrong explains how to dim a fluorescent tube.

Has PE published a fluorescent light dimmer circuit? I would like to dim the lighting in our kitchen/diner. I could replace the fluorescent lighting with incandescent, but I prefer fluorescent light for cooking. Ordinary light dimmers will not work, so is there a practical way to dim fluorescents?

William Jones
Barnsley
Yorks

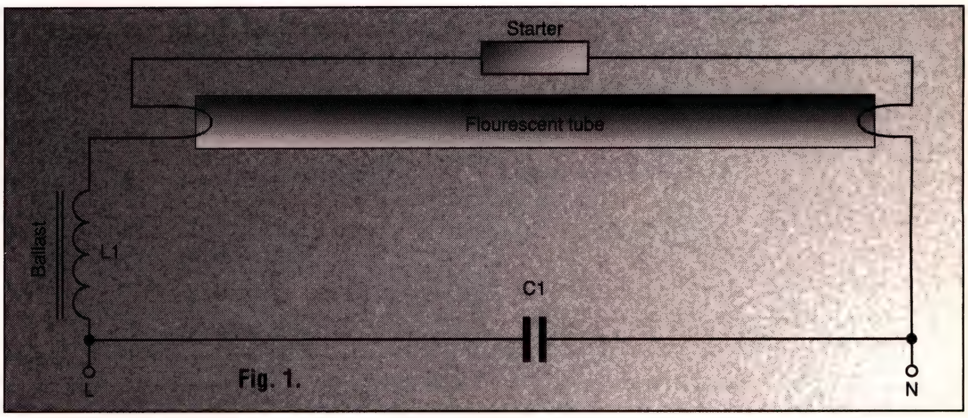

Fig. 1.

It is more difficult to dim fluorescent lights, but it can be done.

Ordinary light dimmers will not work for two main reasons. The first reason is that the current in a fluorescent tube is limited by a series inductor, so that the current is significantly out of phase with the voltage. Conventional lamp dimmers, which derive timing information to phase trigger the triac from the voltage across the triac, receive a waveform to derive phase control information from which depends on the trigger point in the previous half cycle. The best result which is usually obtained by trying to dim a fluorescent with an ordinary dimmer is that the lamp flickers visibly near full brightness, and flashes or switches off at slightly lower brightness.

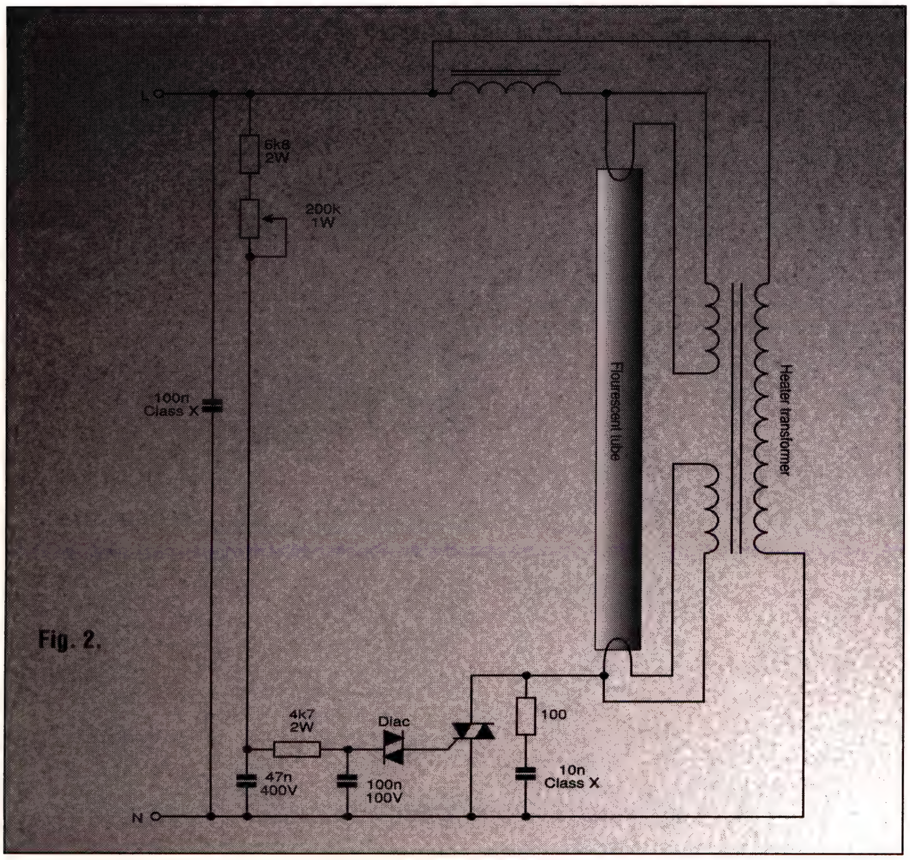

Fig. 2.

The second difficulty is that, in order to strike, a fluorescent tube requires its heaters to be energised. The normal method, illustrated in Fig. 1, is to use a starter, which switches on to conduct briefly when there is a high voltage across the tube. This draws current through the heaters, which begin to glow red. The starter then switches off, normally at a point in the mains cycle at which current is flowing in the inductor (because the current lags the voltage significantly). When the starter switches off, the current flowing in the inductor causes a sharp rise of voltage across the tube, which ionises the gas inside and illuminates the lamp. While the gas in the tube is ionised, there is a relatively low voltage across it, and the starter does not conduct.

So long as the gas remains ionised, the heaters are not required. If too little current flows, or if the current is interrupted for too long, the ionisation fades and the tube ceases to conduct or emit light. However, if the heaters are kept energised, conduction continues down to a lower current, and starts more easily. So one step towards dimming a fluorescent light is to energise the heaters continuously, as illustrated in Fig. 2.

The second necessary step to fluorescent light dimming is to derive phase information from a source which does not depend on the load current. A simple method of doing this is also illustrated in Fig. 2.

The triggering current for the triac is drawn directly from the mains live, rather than from MT2 of the triac. This ensures that the trigger point is accurately phase-related to the mains waveform, rather than to the load current.

The drawback of this design is that the phase shift components are energised all the time, rather than only until the triggering point of the triac. This necessitates the use of higher powered components than would otherwise be required, and may be considered a disadvantage. However, this design has the advantage of simplicity and consequent reliability.

The two-stage phase shift network used in this design minimises hysteresis effects. A single stage phase shift network tends to give the effect, at least on incandescent lamps, that the brightness control must be advanced to a medium setting before the lamp will illuminate at all. The brightness can then be reduced to a lower setting if desired.

The reason for hysteresis is that when the diac fires it discharges the capacitor. the discharged capacitor will charge to a higher voltage on the next mains half cycle than it would have had it been left charged to the opposite polarity. Thus, firing on one half cycle promotes firing earlier on the next, and firing can be maintained at voltages too low to initiate it.

A more complicated but more precise approach is to use the circuit of Fig. 3. In this circuit, timing is derived not from the mains waveform as a whole, but from the zero crossings. Triac triggering is precisely controlled, and hysteresis is eliminated.

In this design, Q1 generates timing pulses derived from the unsmoothed rectified output from the mains transformer. Q1 only switches off very close to the zero crossings of the ac waveform, generating a short pulse which resets the ramp generator.

The ramp generator uses a Norton opamp. This type of opamp gives a voltage output in response to current inputs rather than, as with conventional opamps, voltage. The inputs of a Norton opamp have the voltage characteristic of diodes with the cathode to the negative supply rail. The reset pulse, therefore, raises the inverting input of IC1A to 0.6V, and resets the charge on the capacitor so that the output falls to OV. When the reset pulse disappears, the output ramps up to keep the charging current of C2 equal to the current flowing through R4 and RV1. The calculation relating to this is shown by the diagram.

To generate triac firing information, the ramp waveform is added to a direct current derived from the brightness potentiometer. The component values are calculated so that the comparator will switch on and then remain on if RV2 is fully clockwise, but will switch off for part of the time if RV2 is turned down slightly. When RV2 is set at zero, the peak of the ramp waveform should be just insufficient to switch the comparator. When the circuit has been built, RV2 should be set at zero, and then RV1 should be adjusted so that the triac just does not fire. It may be easier to test this function using an incandescent lamp as the load.

The triac suggested for this purpose is the TIC206M, a 500V 4A device. It might be thought that a 400V device would do, but with a highly inductive load being switched, the waveform could ring to a higher voltage under some circumstances. Other similar triacs would also be suitable, but the TIC206 is suggested because it has proved itself reliable in similar applications. ■

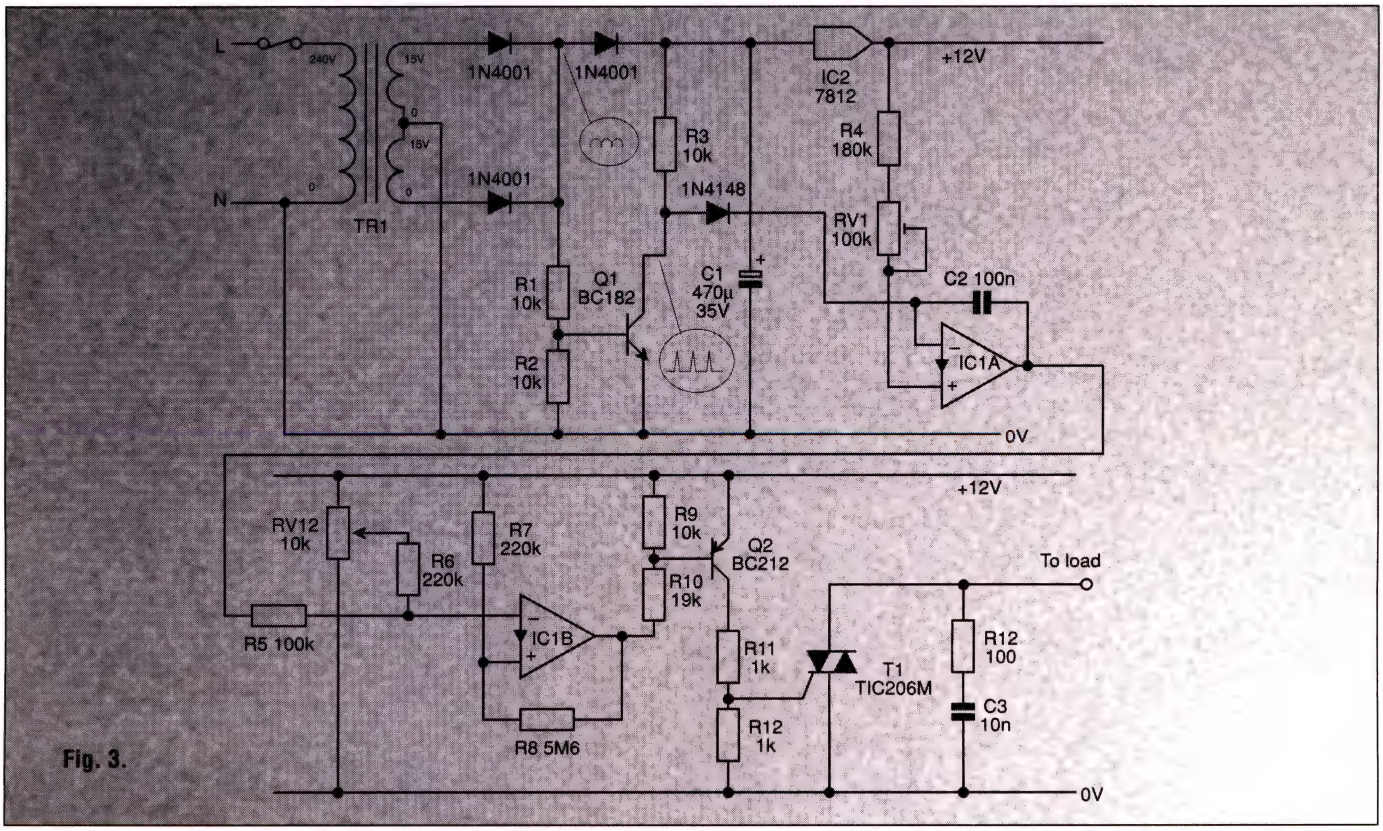

Fig. 3.

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PRACTICAL ELECTRONICS

SCIENCE AND TECHNOLOGY

This month's 25 years looks at reed switches, early Karaoke and Woodpeckers.

September 1966

It seems that European disharmony is nothing new. 25 years ago, PE had a small article on the subject of which system should be used for colour TV. At the time, only B&W was available though people were looking forward to seeing their favorite TV programs in colour. Both Italy and France wanted to use the SECAM IV system while the British were dead set on PAL. At the time it was rumoured that the British televidsion Industry was already ommitted to designing and producing PAL recevivers.

Also in this issue was a feature on reed switches. At the time they were quite new and apart from providing simple switching in the presence of a magnetic field, they can also be used as a magnetic or electronic bistable. The trick is to use a small bias magnet that keeps the contacts in their current state. A larger field is then used to oppose or assist this magnet and open or close the switch.

1976

Karaoke appears to have been developed or at least patented back in 1976. The Sony Corporation of Japan applied for a patent on a device that artificially improves the singers voice to make it resemble the sound of a voice recorded in a professional studio. The idea being that the would be vocalists could then join in with records in their own homes. Both delay and vibrato (frequency modulation) are added to the voice before blending it to the recording. This has had the real singers voice remioved or diminished by cancelling the same sounds that occur on both stereo channels.

1981

This year saw the begining of the electronic music revolution with the Casiotone 202 professional keyboard. Featured in the news section, this instrument was an upgrade of the successful 201. Featuring 8-note polyphony and a 49 note keyboard, the instrument cost a mere £275.

1986

Whatever happened to the Woodpecker? The signals emanating from Riga in the Soviet Union were described in a fascinating article in this issue. Apparently transmitted between 4.5MHz and 30MHz, this the chattering modulation was given the knickname woodpecker. Now that the cold war is over, is it still there? Can we fianlly get the answer as to what it was all about? ■

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A star feature is that no special or custom chips (ie PALs, ULAs, ASICs etc) are used — and thus there are no secrets. The Z80A is the fastest and best established of all the 8-bit microprocessors — possibly the cheapest too!

Although no serial interface is included, it is easy for a Z80A to waggle one bit up or down at the appropriate rate — the cost is a few pence worth of code in the program: why buy hardware when software will do?

Applications already identified include: Magnetic Card reader, mini printer interface, printer buffer, push button keypad, LCD alphanumeric panel interface, 40-zone security interface for auto sending of security alarms, code converter (eg IBM PC keyboard codes to regular ASCII), real time clock (with plug in module), automatic horticultural irrigation controller.

By disabling the on-board Z80A-CPU this card will plug into our Interak 1 CP/M Plus disk-based development system, so if you don't fancy hand-assembling Z80 machine code you don't have to!

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Electronics Made Easy?

Circuit modelling techniques have more uses than just designing electronic circuits. They can also be used in education as Ben Howard found out with Protolab.

The basics of electronics deal with resistors, capacitors, inductors and voltage sources. Learning about them is really a matter of assimilating the various rules/laws and techniques and applying them. Protolab from Global Specialities is designed to aid in the comprehension of basic circuits and give lessons in their basic use.

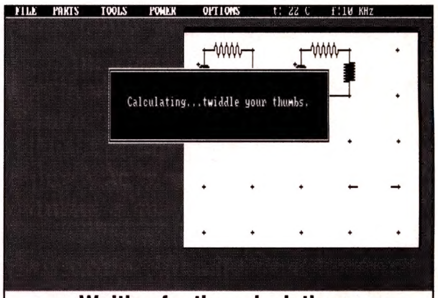
The work area is a prototype board on which components can be placed and connected together. All operations are mouse and menu based and, unfortunately, there are no short cuts via the keyboard – the software doesn't work at all without a mouse which is rather a pity. Putting a component, say a resistor, onto the board means quite a lot of clicking and mouse movement and there is great scope for improvement. Having positioned a component, various values and options can be set up – resistors for example have a value in ohms a wattage and a material such as carbon or wire-wound.

After a little practice, setting up circuits becomes relatively easy and experimentation can get underway. Testing a circuit means connecting up one of the various instruments, voltmeter, ammeter, oscilloscope, or wattmeter, to it after switching on the power. This is derived from a number of possible sources from batteries to AC current generators. The frequency of the latter can be set up to 2MHz with a wide range of voltages.

On applying the power, the rather informative message, "calculating twiddle your thumbs..." comes up. Fortunately, the test was performed on a PC with a 386-33 microprocessor so it only took a short while to examine the circuit. On slower machines the wait could be rather longer and, perhaps, quite tedious.

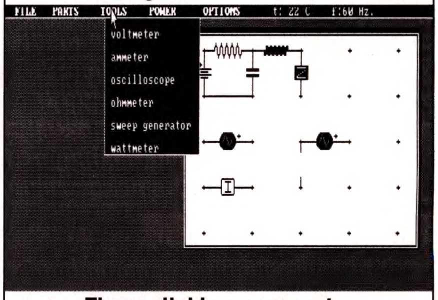
The manual supplied with the package is a large A4 folder with all of the instructions and a selection of experiments. One problem with this is that every time a page was turned, the ring binders spring open and pages begin to fall out. Apart from this, the quality is rather poor but readable.

Protolab provides a way to play around with simple electronic circuits. However, the omission of transistors gives it a rather limited scope although it is not too highly priced it has a rather outdated feel to the user interface which could use a lot of improvement such as colour and a keyboard alternative to the mouse. ■

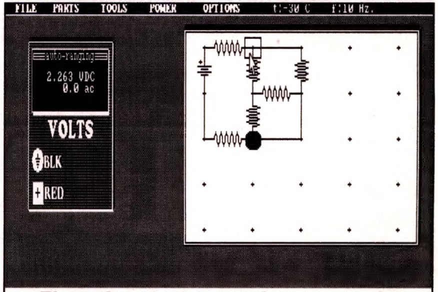


Calculating...twiddle your thumbs.

Waiting for the calculations.

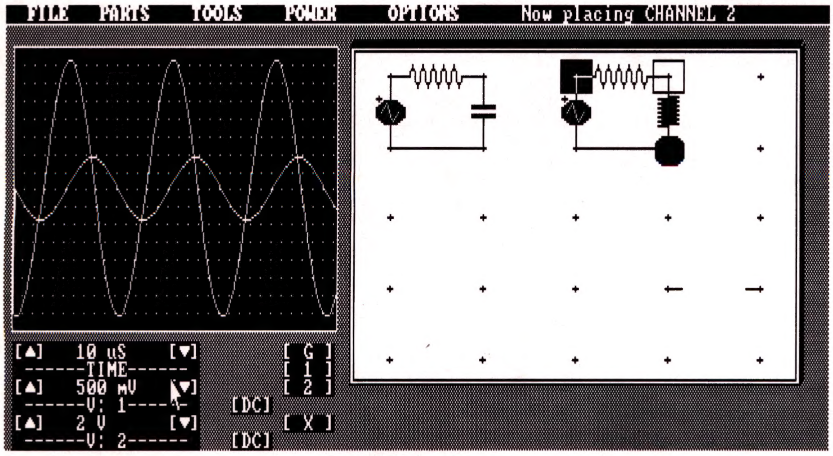


The available components.



2.263 VDC
0.0 ac

The voltmeter on a resistor network.



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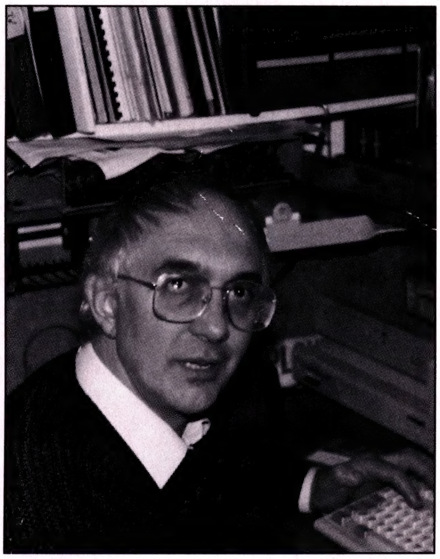
Videos In The Rain

Barry looks ahead to a future where it will no longer be necessary to hire videos.



It is now clearly on the cards that by the mid-1990s the satellite industry will be doing to the video rental business just what the video rental business did to the cinema industry ten years ago.

In the 70s local cinema management was sloppy. Customers had to queue in the rain, often with no advice given on whether they were likely to get in. Once inside they suffered dirty seats, rotten sound and poor projection of old prints. The management seemed more interested in selling hot dogs and popcorn than screening entertainment.

As the video rental business boomed, with literally tens of thousands of outlets across the country hiring films for a pound or so a night, people who wanted to see films stayed at home instead of going to the cinema. Cinemas closed and the rental business grew stronger. In many towns the only way to watch a film was to hire a video or travel to a city centre.

With nearly three-quarters of all homes in Britain now having a VCR, around a million people a day have been hiring videos.

But now the cinemas are striking back, with American-style multi-screen complexes that treat films and customers with respect. A big screen with Dolby surround sound makes the cinema an experience.

The video rental business is hurting. But it will hurt a lot more as the satellite channels get stronger.

No More Programming

The key factor, which the video rental business has so far overlooked, is the use of PDC on satellite movie channels.

PDC, programme delivery control, is a very clever way of letting viewers set their VCR timers without ever needing to know how to set a timer. To cut a long story short, a conventional teletext signal will contain control codes which switch a modified VCR on when a selected programme begins and switch it off again at the end. A primitive PDC system is already in use in Germany, Austria and Switzerland. Britain has adopted an improved system which looks like becoming the standard for all Europe. It is known as Format 2, although obviously a catchy name is needed. "Startext" is mooted.

Simply Press The Button

Channel 4 is pushing PDC, because the station already uses teletext signals to control its programme distribution round Britain. It is a small step for Channel 4 now to start broadcasting the PDC codes for home use. Channel 4 will start PDC coding this autumn and already Philips has promised VCRs with PDC circuitry. Other manufacturers, including the Japanese, have said they will follow. Although the BBC and ITV networks have agreed to the PDC standard, they have not yet committed to providing a PDC service. But the BBC already has plans to automate its distribution network, along the lines pioneered by Channel 4, by 1993.

The real breakthrough could come if BSkyB starts using PDC on Astra. This looks very likely. BSkyB recently started using Fastext, which adds colour page codes at the bottom of the teletext screen. PDC, or Startext, is natural progression. And PDC would seal the fate of the video rental business.

In the simplest form of PDC, a new VCR will display a page of teletext on the screen which gives the present and advance TV programme listings. A button on the VCR's remote control moves a cursor over the screen so that the viewer can select a programme. Pressing another button then sets the timer to record that programme. But the VCR does not actually start until it receives another code which is transmitted as the programme begins. So a VCR set to tape a film at 10pm on Monday, will sit idle until 10.30pm on Monday, or Tuesday, or next month if, for some reason, transmission is delayed.

This is only half the PDC story. When the TV station transmits trailers of programmes to come, it can bury PDC codes inside the signal. All the viewer need do is press a single button on the remote control to set the timer to tape the trailed programme. There is no need to display a teletext page on screen.

So when BSkyB trails a dozen movies, all the viewer need do to tape them is press the remote control button while the trailer is playing. The VCR will then spring to life the first time that movie is transmitted.

This completely changes the rules of the subscription TV game. The satellite movie channels already broadcast scrambled movies twenty-four hours a day. With pay-per-view access control (which advanced scrambling systems already allow) these channels can transmit movies which would otherwise only be available on rental or in the cinema. Viewers will set their recorders to tape these movies while they are out or asleep, by using the PDC push button.

When this system is up and running, who will want to go out in the rain to the local video library and find that all copies of the film you want to see are out on loan? ■

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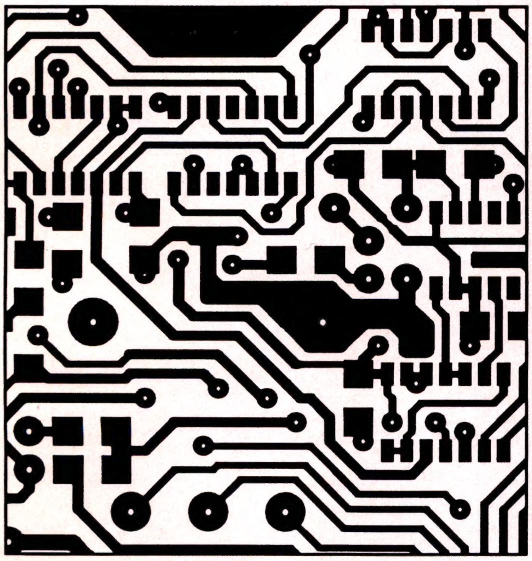

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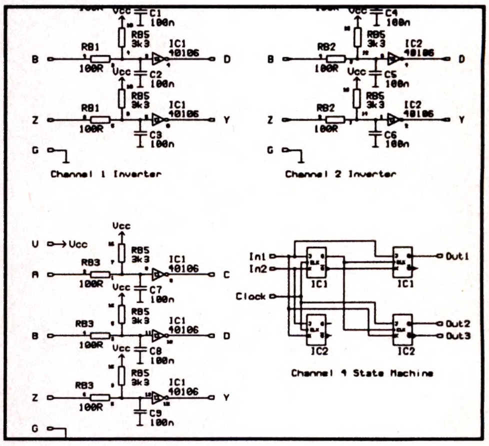

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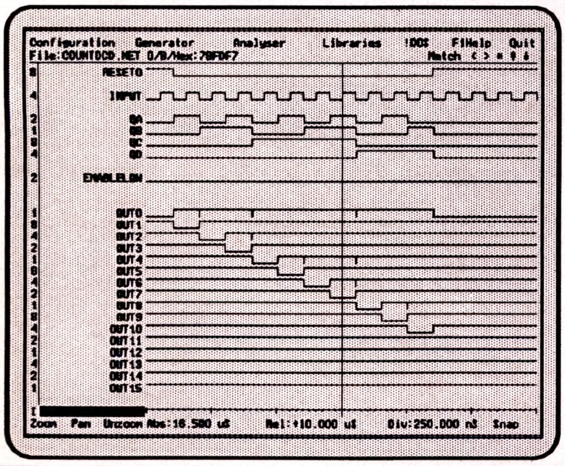

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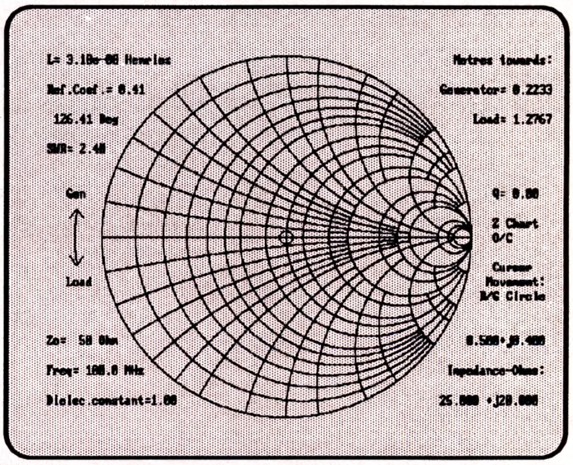

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